1957

TECHNOLOGY DEPT.

Gas Journal

VOL. 292. 109th YEAR. LONDON, DECEMBER 18, 1957 No. 4927 PRICE 1/6

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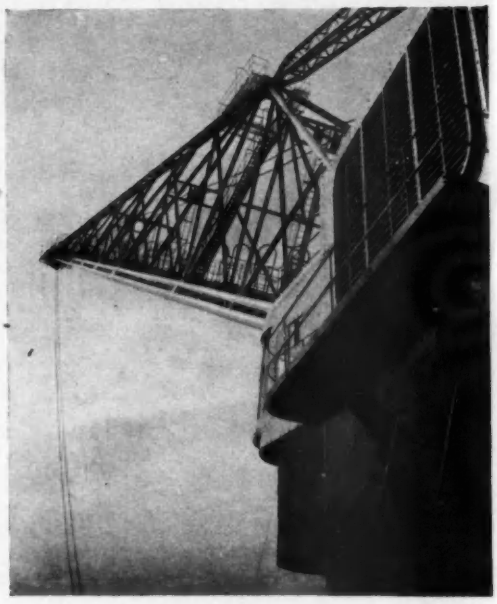

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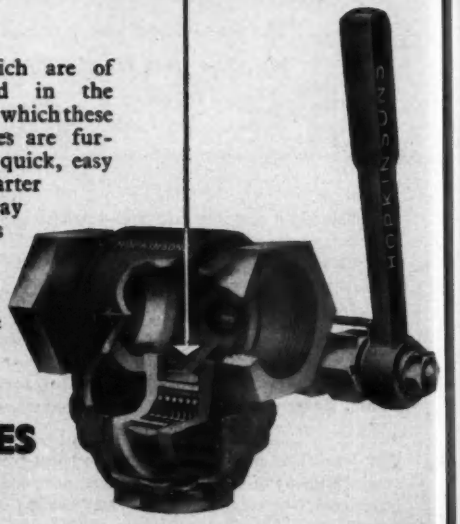

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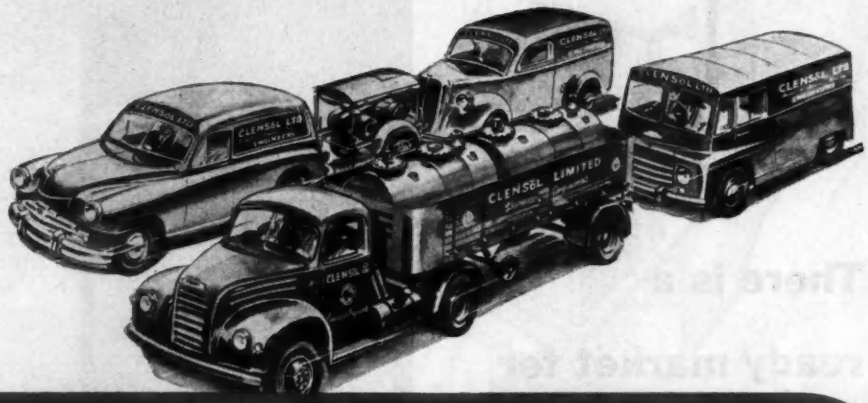

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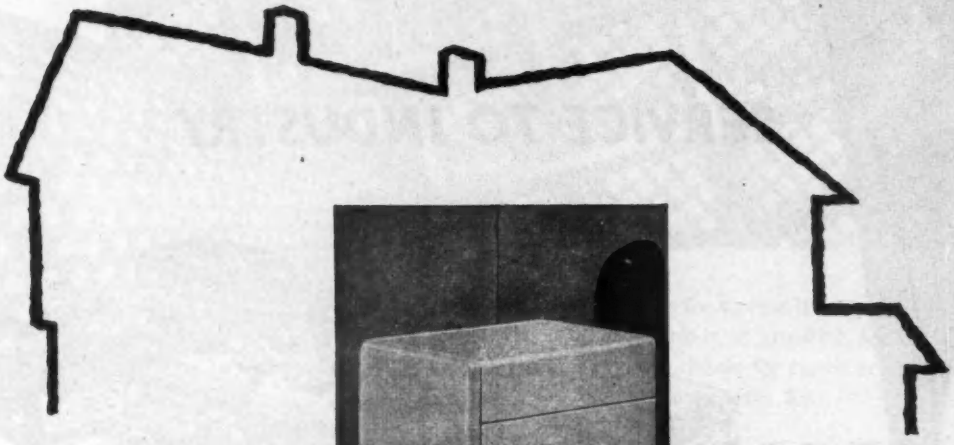

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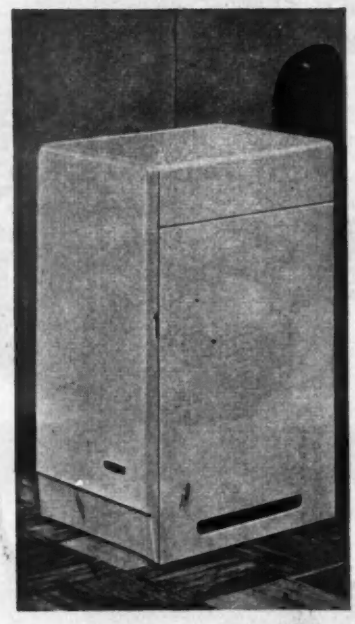

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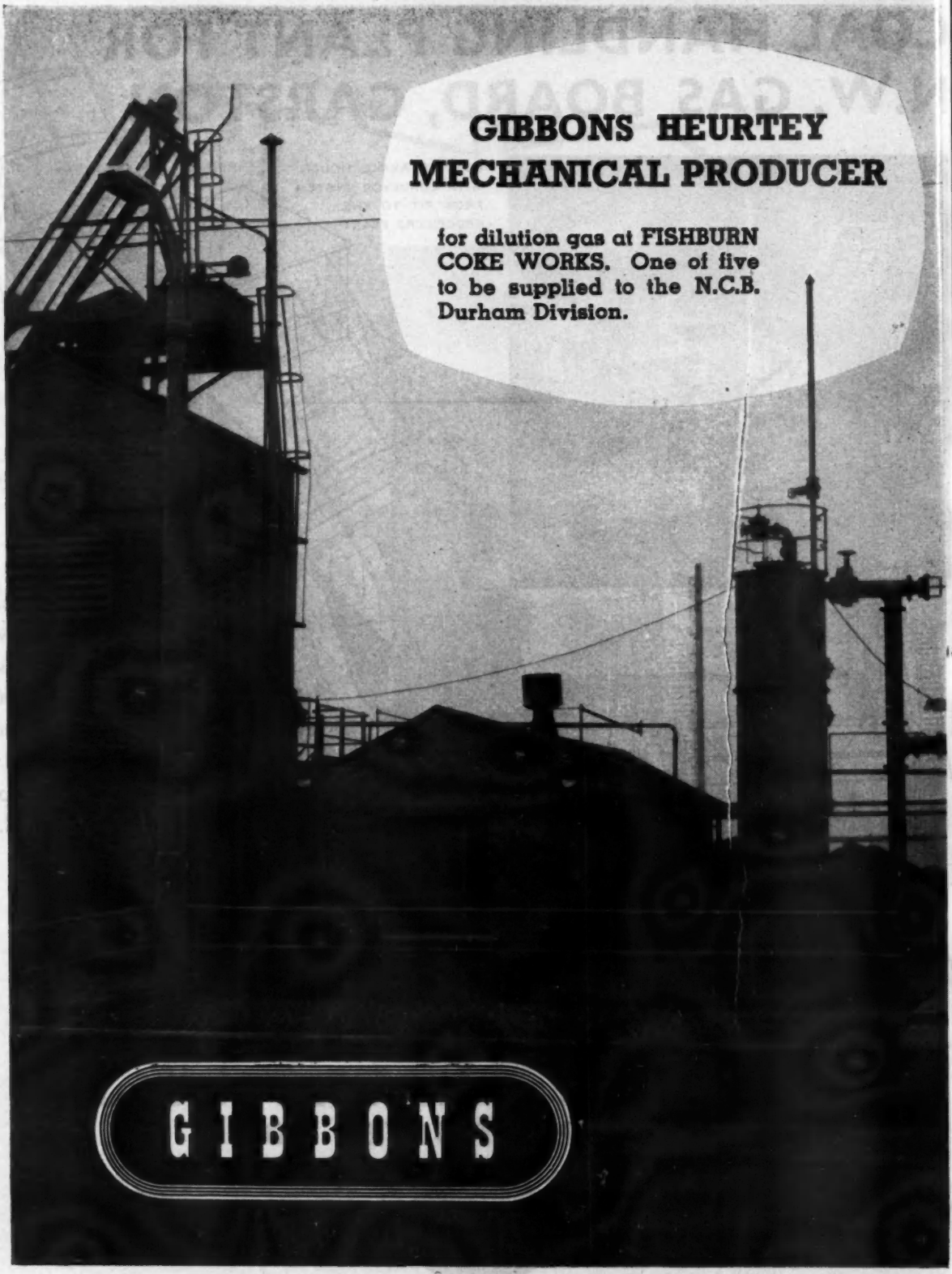
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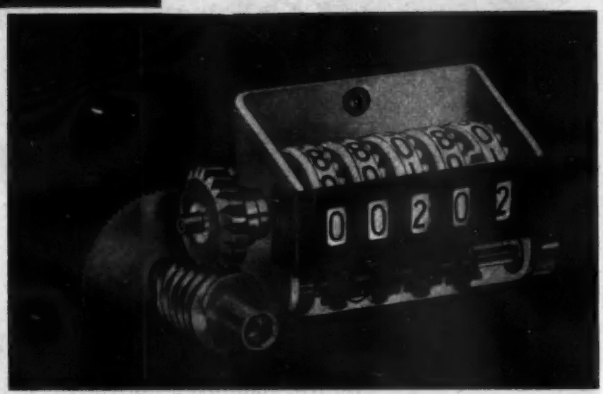

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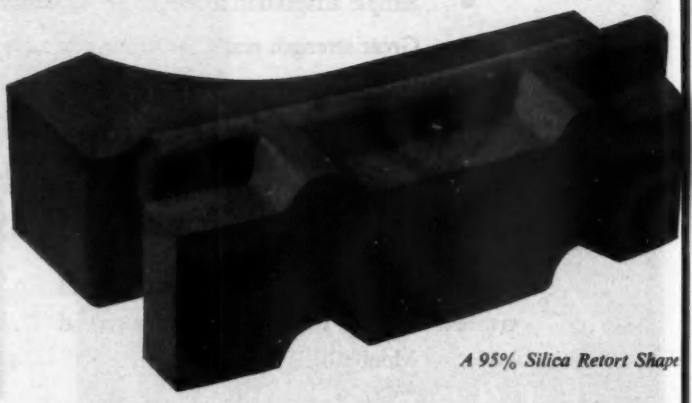

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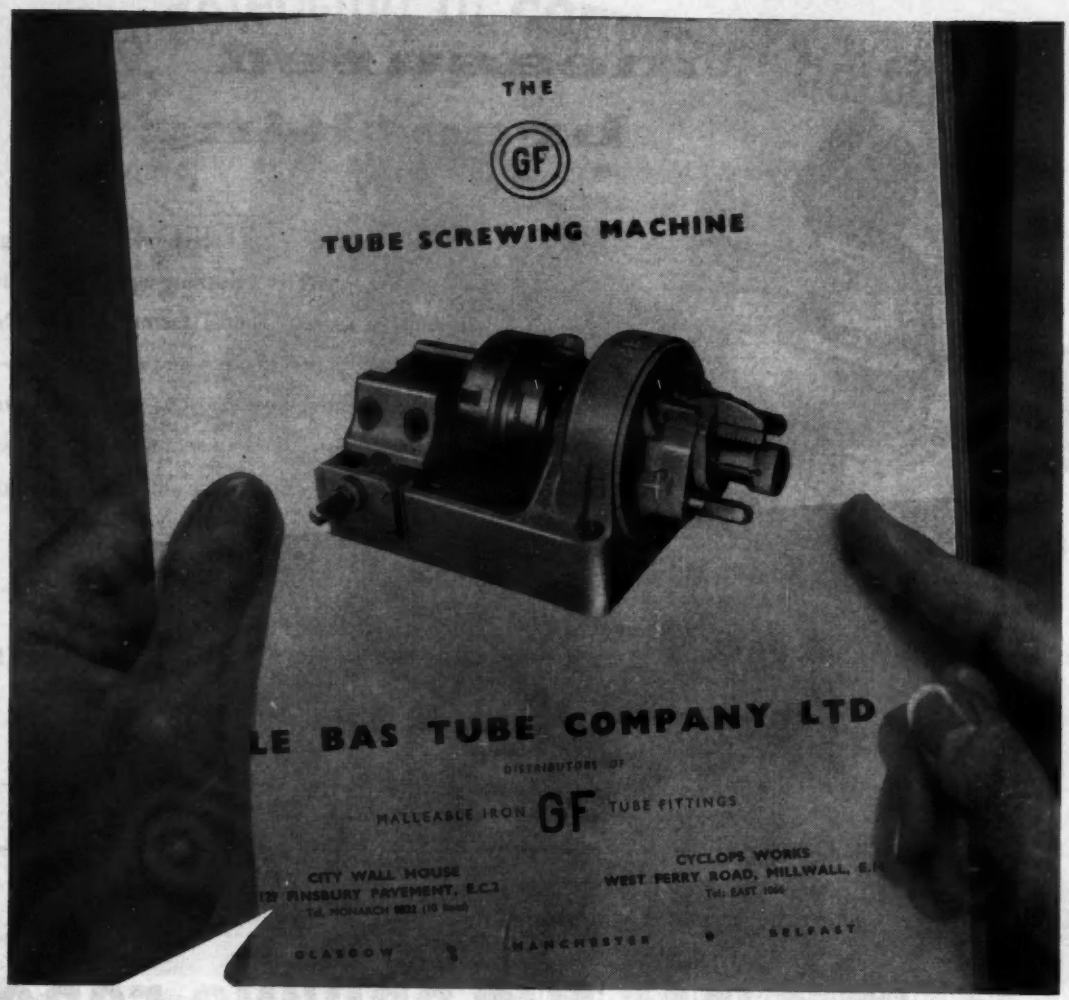

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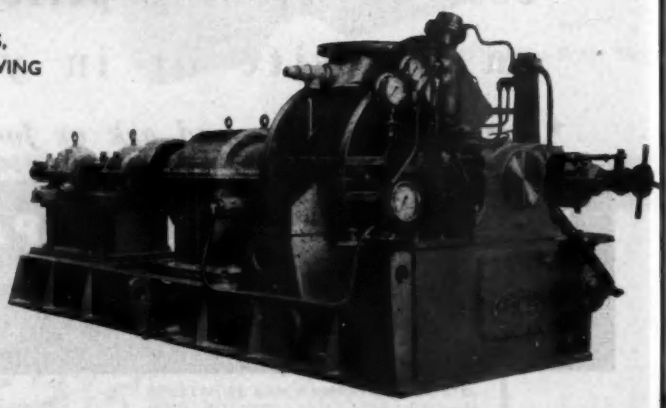

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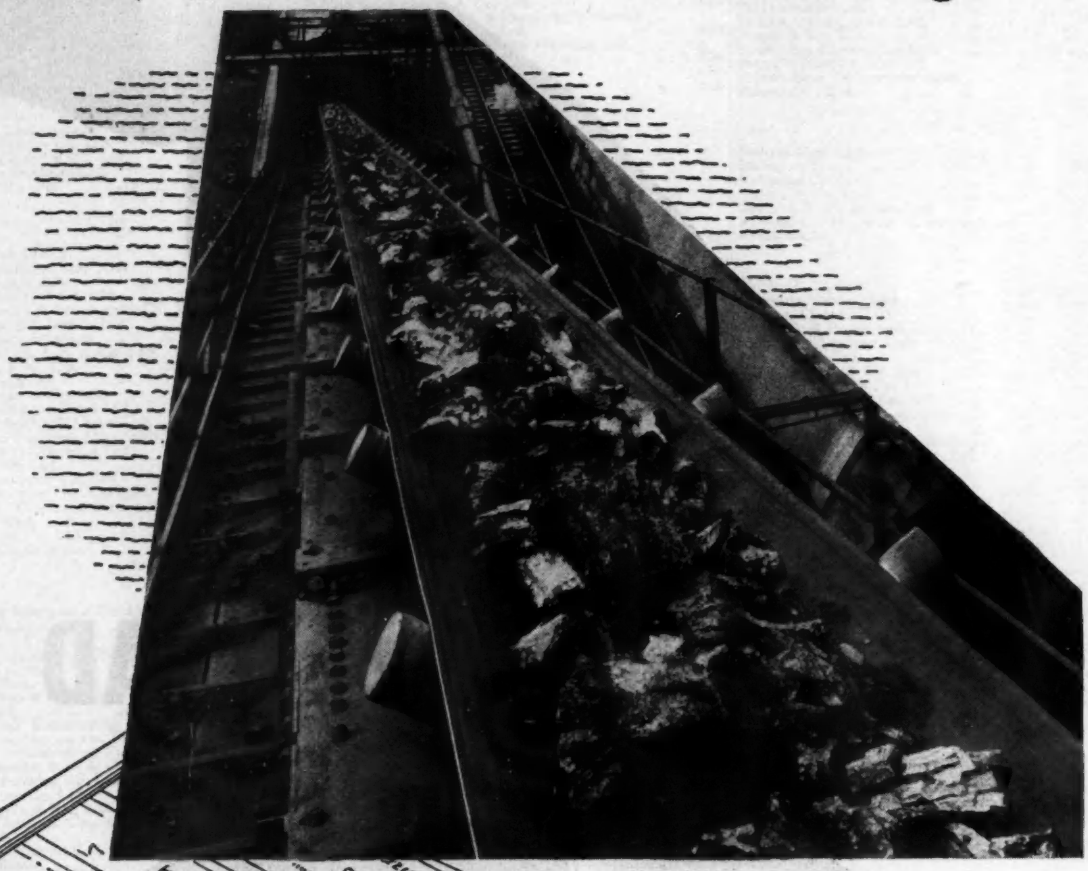

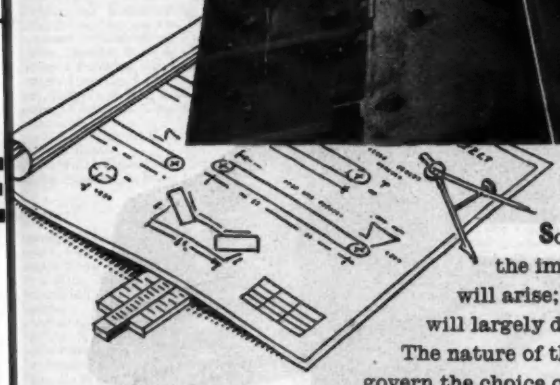

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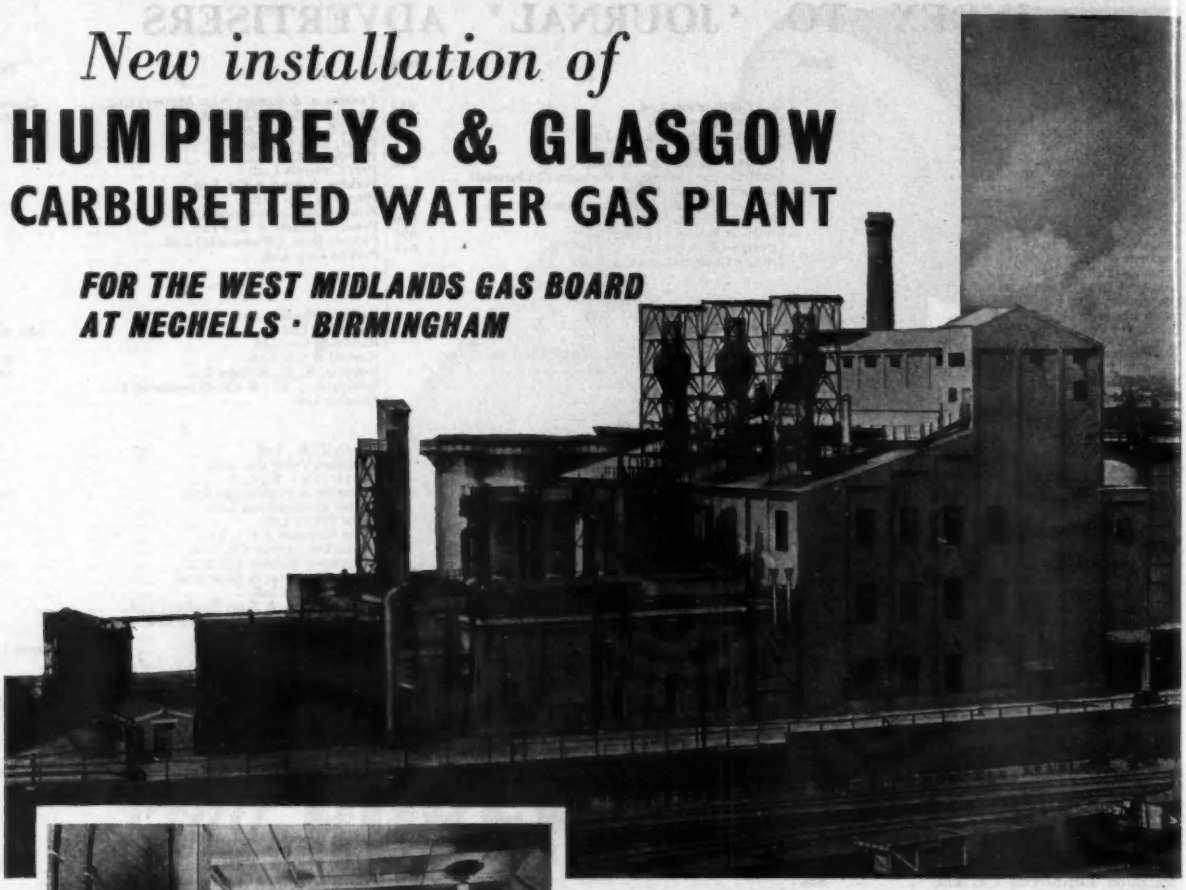

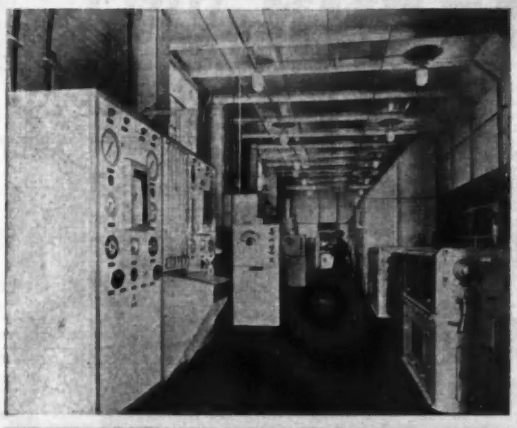

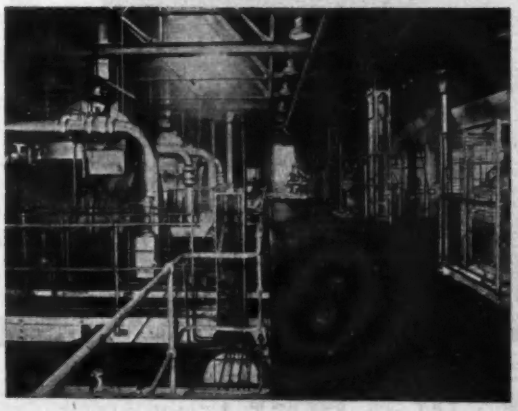

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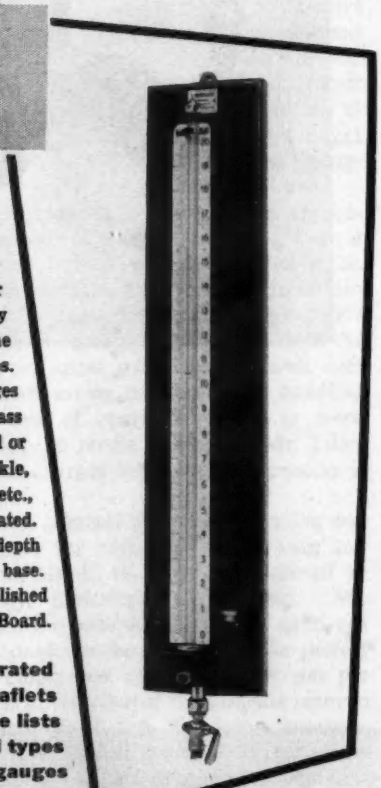

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THOMAS THORP & CO LTD WHITEFIELD Manchester

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Gas Journal

VOL. 292 NO. 4927 December 18, 1957

109TH YEAR

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HULTON PICTURE LIBRARY

something in common

They remind one of different worlds, the antique chair of 1680-1700 and the modern T.G. meter. Yet they *have* something in common — both are the products of true craftsmanship. The chair, in the style popularly known as 'William and Mary', is attributed to Daniel Marot who designed much of the furniture for Hampton Court Palace. It is presented here as a fine example of furniture design of that period and a worthy sample of the chairmakers' art. The T.G. meter epitomizes craftsmanship and T.G. 'G' prepayment mechanism is accepted as the most modern precision movement on the market.

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Gas Journal

VOLUME 292. No. 4927. DECEMBER 18, 1957. 109th YEAR

Oxide Purification at a Profit?

AT the Annual Meeting of the Manchester and District Section of the I.G.E. in March, Mr. Hodkinson exhorted the members to receive papers presented to them with lively and uninhibited discussion. He would have been fully satisfied with the reception on November 8 of Mr. Hollingshead's paper entitled 'Conventional Dry Purification of Coal Gas at Minimum Cost,' a title which one speaker said might well have been 'Conventional Purification at an Unconventional Profit.'

In a nutshell, the 'conventional' practice of spreading the fouled oxide out, turning and watering it on a revivifying floor, was, over a period of years at St. Helens, found to be unnecessary. The oxide is discharged from the box, disintegrated and returned to the same box. And this is repeated three times until the sulphur content of the spent oxide reaches well over 50%. The consequent saving in labour and handling costs results in a cost of operation which in some periods showed a definite profit, though, as Mr. Tilley put it, 'when capital charges are added the process is still in the red.'

One of the points of contention in the discussion was the rating of purifiers for capacity. In a long and detailed contribution, Mr. L. G. Townsend, himself an established authority, preferred the R ratio. Mr. Hollingshead dislikes the orthodox R Ratio—cu.ft. gas per hour per cu.ft. oxide in the first box. He prefers what he calls 'the empty box velocity'—cu.ft. gas per minute per area of box. Neither of them would seem to be completely rational. Mr. R. J. S. Thompson, however, suggested that the R ratio had outlived its usefulness and proposed that it should be replaced by 'total contact time in seconds.' That would certainly have the virtue of rationality. He suggested that good practice would be 500 seconds for gas containing 500 grains of H_2S per 100 cu.ft. Mr. Hollingshead, with 580 grains in his gas, had started with 400 seconds in his first fouling, his second at about 500 seconds and his third at about 570 seconds. 'In other words, he has 570 seconds capacity which he reserves for his final fouling.' Mr. Thompson described as a discovery that in the first and second foulings, when the oxide is in good condition, the contact time could be reduced to something much lower than that normally allowed. The advantages of the discovery, clearly set out in this paper, had been demonstrated over a period of several years.

Turning back to GC7, Dr. Moignard's classic paper of 1952, on the 'Performance of Oxide Purifiers' (preoccupied as we were then with the problem of oxide hardening) calls attention to the recommendation of the first Report, G.R.B. 43, to operate with as high a throughput as possible, essential not only to reduce the incidence of capital cost but necessary to obtain short exposures without excessive oxide handling.

The supply of air for *in situ* revivification also excited some controversy. The purifiers at St. Helens were found to be suffering from 'oxygen starvation.' It was interesting to note the claim for improvement resulting from the change-over from the use of the Orsat to that of the apparatus described in the Appendix to GC7.

Air admission was increased from 4% to 5% with beneficial results. It is a pity that this was necessary because the introduction of nitrogen must, of course, increase the inert content of the purified gas and reduce its calorific value. Mr. Wickstead pointed out that the consequent reduction in thermal yield in the retort house might have an appreciable effect on the cost of gas into holder. Dr. Moignard recommended avoiding excessive oxygen concentration and, incidentally, second-box air admission, which apparently was not practised at St. Helens and which would appear to have the advantage that less air would be required. Mr. Thompson made an interesting reference to recent experiments in Scotland in the use of oxygen instead of air for this purpose.

There are a number of other factors entering into oxide purification. There seems to have been little or no difficulty with hardening anywhere in the South Lancashire Group. Little or nothing is said of methods of control of the reactivity of the new oxide—of mois-

ture (to which Dr. Moignard attaches so high an importance)—or of temperatures throughout the sets. One will again go to Dr. Moignard for an exhaustive treatment of these and other aspects of oxide purification.

Mr. Wickstead brought out one other, perhaps minor, point. The main item in the saving effected by the new method is labour cost, but this can only be a real saving if the labour thereby released can be usefully employed on other work. The saving can be realised if the labour force on purification can be so distributed among several works of an integrated group, and so synchronised between them, as to be kept fully employed.

Gas for Scotland

MR. SYDNEY SMITH'S latest weapon in his fight to make Scotland 'appreciate the vital rôle which the gas industry must fulfil in the country's domestic, commercial and industrial life, if the national economy is to be as sound as we would all wish to see it' is the publication of a first-class booklet called *Gas for Scotland*. In his foreword Mr. Smith writes of the dangerous failure in a number of responsible quarters in Scotland to accept the contribution which the industry can make to an improved standard of living. The booklet is being sent to members and officials of local authorities throughout Scotland, to all Scottish Members of Parliament, to Scottish Government departments, and to architects, consulting engineers, builders, surveyors and many others who are concerned with planning the use of our national fuel resources.

It is pointed out that for many years to come there will be a gap between the country's total energy requirements and supplies available from coal and nuclear power. The Scottish gas industry is steadily improving the productive efficiency of the orthodox processes of carbonisation. 'But these conventional processes' states this publication 'are not now the only ones.' As pointers to greatly increased gas production combined with savings in the use of high-grade coal, the booklet cites the Scottish Gas Board's plans for high-pressure complete-gasification of large deposits of low-grade coal in Fife, the greater use of coke oven gas, and the possible availability of 'tail' gases from oil refineries and of imported natural gas and methane drained from collieries.

Kindly Light

IT is frequently said in the British gas industry that it is essential to find new loads. A recent article in the journal of the American Gas Association suggests that we may have missed a trick by failing to exploit a nostalgic taste for *outdoor domestic* gas lighting. There is of course a handful of enthusiasts who collect the graceful street lamps of a bygone age, but to the best of our knowledge there has not been an acceptance by householders of the beauties of gas lighting in their gardens. According to the A.G.A. monthly, 'Homeowners are now discovering that the radiant glow of gas light enhances their modern low-slung homes even more than it enhanced the lofty homes of a half-century ago.'

It is pointed out that the outdoor gas lamp is both attractive and functional serving as an excellent advertising tool. 'A gas lamp glowing in the dusk or dark spells out GAS more effectively than a sign 10 ft. square.' Moreover, it is a base load appliance which consumes as much gas as the average domestic cooker. And unlike other appliances, it can often be sold in large quantities. A Southern Union Gas salesman, for instance, recently sold 35 Moonglow gas lamps—the equivalent of 35 cookers—to the Robin Hood Inn in Albuquerque, New Mexico.

It is easy to sell. Once a gas lamp has been installed in an area, customers—both residential and commercial—ask for similar lamps. Cities that have discontinued gas lighting find that customer demand for old street lamps far exceeds the supply.

A recent issue of *Greater Pittsburgh*, publication of the Pittsburgh Chamber of Commerce, quotes R. T. McCrum, supervisor of comercial sales for Equitable Gas Company, as saying that 75 of the antique gas lamps formerly in use on Pittsburgh streets have now been located and are again in service throughout the Greater Pittsburgh area.

The main supplier for indoor gas lighting in the United States is the General Gas Light Company, of Kalamazoo, while the main supplier for gas street lamps is Welsbach Corporation, of Philadelphia. The leader in the manufacture of the more common gas lights—the lamp-post type—is the Moonglow Gas Light Company, of San Antonio.

It would be interesting to know what our friends William Sugg & Co., Ltd., think about it all.

Advertising After Dark

THE previous item reminds us that in far too many gas showrooms insufficient thought is given to the provision of adequate lighting. The days of the cosy hissing of gas lighting in our showrooms are almost, but not quite, gone. Instead we have very sensibly employed our competitor's fuel. Surely it cannot be some curious reluctance to make proper use of electricity which results in dimly lit windows which fail to compete with the attraction of the surrounding shops? We have just seen three showrooms, two in one board's area and one in another's, which strengthen our point.

In the first showroom the windows (they were of the open type) were tolerably lit, but owing to the total absence of lighting in the showroom itself, the window gazer peered through into a cavernous gloom in which could be faintly distinguished the huddled shapes of appliances and furniture. The second showroom had closed windows containing some of those rather amateurish 'home made' displays of which certain showrooms managers are oddly proud. As a result of lighting of almost unbelievable dimness the displays took on a nightmarish quality, the grinning cardboard faces looking like a corner of the Chamber of Horrors. For some reason the third showroom had more lighting in the showroom itself than in the (open) window; the result was to silhouette the appliances on display and to make the price cards, etc., difficult to read.

The reader may well ask why we have included these criticisms in this journal instead of publishing them in our sales publication, *Gas Service*. The reason is that many lighting schemes are held up because expenditure on improved fittings, etc., has not been sanctioned and we feel it our duty to urge those concerned to regard such expenditure as necessary and indeed vital. We are all agreed that the industry must step up its sales. How this can be achieved when the dog cannot see the rabbit—or rather, the customer see the goods? Window gazing after dark is recognised as a strong sales stimulus. Let us make the most of it—and while we are about it, let us make sure the word GAS can be clearly seen.

Tour of R. & J. Dempster's 8½-acre Manchester Works

100 ATTEND MANCHESTER JUNIORS VISIT

MANCHESTER and District Junior Association of Gas Engineers visited the works of R. & J. Dempster, Ltd., Newton Heath, Manchester, as part of their second November meeting.

More than 100 members and guests engaged the attention of 12 guides who showed them over the 8½ acres of land housing buildings and machinery.

At the time, 350 people were employed in the works and 350 more on outside erections. The visitors, who included Mr. J. K. Lord, President, and other officers of the Association, were greeted by Mr. Leslie J. L. Walker, Managing Director; Mr. F. Bailey, Works Manager, and Mr. C. H. Davidson, Sales Representative, among other executives.

At dinner, Mr. Lord presided. Mr. A. H. Barrington, of Stretford, who moved a vote of thanks to Dempsters Ltd, for a first-class visit and generous hospitality, expressed deep regret at the unavoidable absence of Mr. Charles Dempster, Chairman of the firm. He asked Mr. Leslie Walker to convey the Association's thanks to him.

Strenuous Time

Mr. Barrington said he must acknowledge the Association's indebtedness to Mr. Walker himself, Mr. Davidson, Mr. Bailey and particularly the guides who had had a rather strenuous time. The canteen staff, too, had given the visitors excellent service.

Mr. Walker, replying, said Mr. Dempster was very sorry he was unable to attend the dinner. He would appreciate the kind sentiments expressed by Mr. Barrington It was about ten years since the Association had visited Dempsters' works but Mr. Walker hoped there would not be such a long interval before the members went there again.

As representatives of the firm he and his colleagues had tried to make the visit interesting and hoped they, as members of the Association, had enjoyed it thoroughly.

A paper was read by Mr. R. B. Niezgoda, Research and Development Engineer of the firm, called 'Some thoughts on the treatment of effluents from carbonising plants.'

Foundation of the firm dates back to 1885 when, to meet the growing needs of the gas industry, the late Robert and John Dempster, transferred their business to the present gas plant site. Meticulously concerned for the needs of their clients it was not long before they realised rewards by a steadily increasing demand for their products.

Alterations and extensions to the plant became imperative. The workshops and tackle stores now cover more than eight acres and include an up-to-date boiler shop for the manufacture of all types of steelwork, including gasholders and tanks; a fitting shop for working all classes of mechanical equipment required in connection with the various kinds of gasworks plant; a pattern shop, and a foundry producing the highest class of castings from thousands of patterns that may be always seen in the stores.

A gas-heated furnace has been installed for heat-treating and stress-relieving welded steel products such as mains, pressure vessels, and other components up to 20 tons in weight and, in special circumstances, up to 52 ft. in length. The temperature of this furnace, the visitors were told, was sufficiently controlled, and the operating temperature was 0°C. to 800°C.

Gamma-ray Testing

Available services include facilities for the thorough examination of welding—by means of X-rays, and the use of isotopes for Gamma-Ray testing where necessary.

The modern extension in the technical departments and workshops have vastly increased the scope of the firm's activities, enabling them to maintain a complete and well-balanced organisation for the design and construction of plant for the gas, chemical and allied industries. All their productions are the outcome of close co-operation in research, development, design and construction, representing the best modern practice under exacting economic conditions.

There are many features of the firm's products that are worthy of particular attention.

For instance, in the design of the cross-tube flow condensers, full consideration is given to water velocity and the prevention of thermo-turbulence. Visitors saw the 4 mill. cu.ft. per day capacity type, and the recently completed tray purifier installation, manufactured under licence from the patentees (Carr & Litler) with a capacity of 7 mill. cu.ft. per day. It is claimed for these purifiers that they are economically designed and can be seen to ease arduous labour conditions which have long been accepted as inevitable in dry box purification, in addition to the rapidity and simplicity of the operation of changing boxes.

What they Saw

Much could be written about their waterless gasholder bay with its large plate rolls specially adapted to put the necessary sweep into the long vertical sheets of their patented welded gasholders; a special machine for flanging the side plates of the waterless and welded gasholders, a machine made by the Maschinen-fabrik Augsberg Nurnberg Company, of Germany, of which there are only a few in the world; the five-cutter milling machine, manufactured by J. Hetherington & Sons Ltd., to Dempsters' design; the fitting and machine-shop beyond a 100 KVA diesel-driven generating set—a part of the firm's contribution to load-spreading—where all the mechanical work is carried out with all its implications; and many other things.

WALES & MON. JUNIORS VISIT J. H. ROBINSON WORKS

MEMBERS of the Wales and Mon. Juniors visited the works of J. H. Robinson & Co. (Liverpool), Ltd., recently, to see the manufacture of gas meters, domestic gas water heaters and hot brass pressings, in brass, copper and light alloys, for use in gas, electrical and allied industries. The works occupy a three-acre site in Mill Lane, Liverpool; land for further expansion is available. More than 500 people are employed.

The new non-ferrous foundry incorporates many new features for efficient working. Special attention has been given to welfare facilities in this department. The latest type of gas-fired furnaces are in use, and the foundry has a capacity of 2,000 to 2,500 tons per annum. Special ventilation plant has been installed, making for working conditions of the highest standard.

The Chief Metallurgical Chemist in the new laboratory is in charge of the casting of rod to the various specifications.

Interest was shown in the tool room, which is equipped with a range of precision machinery, modern profiling, three dimensional profiling and spark erosion machines. Here, all the gauges, tools, jigs and fixtures designed in the drawing office are made.

In the meter shop, the skill of the meter maker is preserved, each tradesman being responsible for assembly. A code letter scheme indicates to supervisory personnel the stage each meter has reached, and what service the meter maker requires. This enables a consistently high standard of manufacture. This system is also in operation for the repair and maintenance of meters. The meter test shop provided an insight into the latest methods of testing and control.

In the water heating department were seen the '393' and '525' heaters in all stages of manufacture, including assembly and testing. These heaters are

now available in white, hyacinth blue, eau-de-nil, mushroom pink, ivory and primrose.

The hot stamping department was of special interest; new friction and other types of presses being seen in operation. In the light press shops was seen the manufacture of meter and water heater parts. Special interest was paid to the automatic press feeding equipment.

Tour of the Works

In the large machine shop were seen the latest capstans and automatics, together with high precision fine boring machines. The stress was on accuracy and interchangeability, and there is a special colour system for production continuity.

Other interesting places seen were: The various assembly departments and the plating and finishing department, where chrome, nickel and other usual finishes of gas, water, electrical and engineering products were inspected.

N.C.B. TAKES OVER TAR DISTILLERS

THE Durham Division of the N.C.B. are to buy the tar distilling and chemical manufacturing firm of Thomas Ness, Ltd., at Darlington. The identity of the Company will be retained and the name will remain unchanged.

Dr. Reid Chairman

The directors of the Company will include five members of the Durham Division of the N.C.B. and three members of the old Ness board will continue as full-time directors. Dr. Reid, of the N.C.B., will be the board's Chairman.

WILLIAM SUGG & CO., LTD.

Three Factors Cause Fall in Year's Trading Profits

IN his address to the annual general meeting of William Sugg and Co., Ltd., in London, recently, the Chairman and Managing Director, Mr. W. T. Mattock, reported a substantial fall in trading profits. There were three main causes:

The extremely mild winter of 1956-57, the cancellation of a large Government armament contract in the final quarter of the financial year, and a considerable fall in the price of copper necessitating a substantial write-down in the value of raw material stocks.

All their efforts during the year under review had been devoted to the development of appliances, the sales of which might be expected to go some way toward replacing the lost Government work. One new development, their system of 'selective air heating' by the use of the proven Halcyon heater, seemed likely to achieve great success.

Bulk orders had already been received from the North Thames and South Eastern Gas Boards, and the prospects in Scotland were most encouraging. Other demonstrations in each gas board area were being arranged during the next few months.

Interim

The net profit, after allowing for taxation, was £3,487 compared with £14,830 for the previous year. An interim dividend of 5%, less tax, had been paid, and the Directors recommend a final dividend of 5%, less tax, with a distribution of 2½% in respect of capital profits.

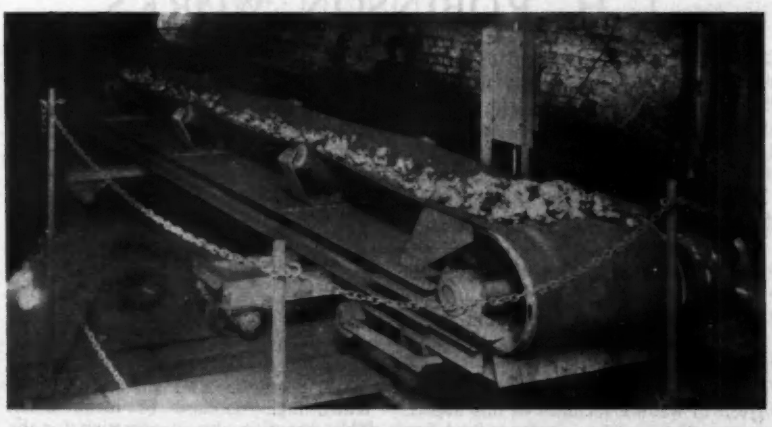
EIGHT NEW MEMBERS WELCOMED TO MANCHESTER SECTION

MR. R. L. GREAVES, M.B.E., Chairman, welcomed eight new members to the Manchester and District Section of the I.G.E. at the autumn ordinary general meeting held at Manchester.

Presenting certificates to four members, Mr. Alexander McDonald, a guest, said that although the certificates were not a guarantee of promotion, they were a big step towards it. Many candidates failed to secure positions or promotion because they lacked personality, which he likened to a mosaic of several small pieces including appearance (which some possessed naturally, and others cultivated), clear speech, clear thinking, sound judgment and an understanding of human beings.

Mr. C. R. Hollingshead, Group Chief Chemist, South Lancashire Group, N.W.G.B., gave a paper on 'Conventional dry purification of coal gas at minimum cost.'

Special T. & T. Conveyor



Pictured above is a special conveyor installed in the Stafford works of the West Midlands Gas Board by T. & T. Works, Ltd. It has 24 in. belt, 51 ft. 6 in. centres and is arranged on bogies to run on a series of rails placed at right angles so that the whole conveyor can be shifted sideways and at the same time the belt is fed by a hopper which is arranged to travel longitudinally along the length of the conveyor. This enables feed to be taken as desired from four rows each of eight retort outlets, the hot coke being conveyed into the feed hopper of the main screening plant elevator, seen bottom right.

Photo by courtesy of the W.M.G.B.

Diary

December 19.—INSTITUTE OF FUEL: Great George Street, London, S.W.1. 'Russian Coal Mining and Fuel Technology,' Dr. W. Idris Jones. 5.30 p.m.

December 20. — NORTHERN JUNIORS: Darlington. Short paper meeting for the 'A. C. Hovey' award. 2.15 p.m.

December 24. — YORKSHIRE JUNIORS: York, 'Random Thoughts—Installations,' by H. Cartledge.

YORKSHIRE JUNIORS

THE first meeting of the Yorkshire Junior Gas Association's 1957-58 session, under the Presidency of Mr. E. S. Carter, was held at Doncaster on November 23. Mr. J. A. Whitworth, of Hull, gave a paper on 'Safety governors and low pressure alarms.'

Change of Address

From January 1 the London address of the Self-Priming Pump & Engineering Co., Ltd., will be Pulsometer House, 20-26, Lamb's Conduit Street, W.C.1. Telephone, Holborn 1402 (5 lines). The works address remains unchanged at Edinburgh Avenue, Trading Estate, Slough, Bucks.

TRANSATLANTIC CABLE :: TRANSATLANTIC CABLE :: TRANSATLANTIC CABLE :

FROM HILDING CARLSON :

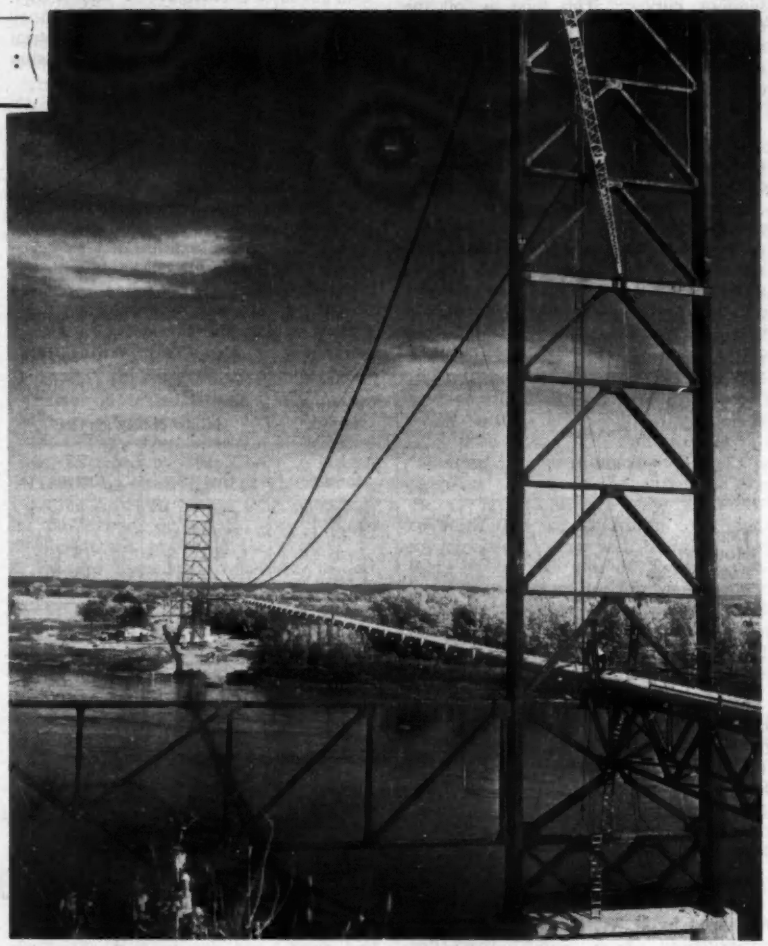
NEW YORK.—December 12

'PHONY obsolescence.' When the editor of the largest American appliance publication uses those words as the heading for his full-page editorial he must be awarded an 'A' for courage and another for his forthright expression—American appliance merchandising being what it is. No late-comer in admiration for Mr. Laurence Wray, Editor of McGraw-Hill's *Electrical Merchandising*, we cheer again after reading his November Fugue.

The chaotic conditions in the appliance industry, wrote Mr. Wray, have had large contributions from the practise of 'bringing out new models every year, regardless of whether any basic product improvement is involved.' He was echoing, with rather apparent agreement, the criticism of that practise given by Mr. Fred Maytag, President of a major appliance manufacturing firm.

The contention is that in the appliance industry, 'the concept of artificial obsolescence has not . . . served to benefit any of the interested parties: The consumer, the dealer or the manufacturer.' '*. . . in America the new appliance or motor-car is not bought as a permanency and no attempt is made by manufacturer or salesman to give the purchaser the idea that it is. On the contrary he is urged to scrap his new acquisition in a year or two and replace it with the latest developments which have taken place in the meantime.*'

That neat description summarised the situation, under the heading, 'American Approach,' by the Editor of 'GAS SERVICE,' September, 1956. It is accurate, except for the all-encompassing 'latest developments.' In America, new models



'The most beautiful new bridge in America' built in 1956 has just been selected by the American Institute of Steel Construction—and it is a gas pipeline bridge, 3,331 ft. long. Spanning the Missouri River at Plattsmouth, Nebraska, the bridge was built to carry twin 30-in. lines of Northern Natural Gas Company. At its lowest point, the bridge is 70 ft. above the standard highwater, permitting passage of the largest vessels that use the river. Cost of the bridge has been set at £571,425. Earlier pipeline installations by the Northern Company, at the same point on the river, are a 24-in. line on a vehicular bridge and two 20-in. lines make a submarine crossing.

Appliance Maker Attacks 'Annual Face-lifting'

are not synonymous with new developments.

Mr. Maytag was quoted in *Electrical Merchandising* as commenting that in his company there is the 'basic philosophy that model changes should represent significant improvement in product—not simply an annual face-lifting.'

Mr. Wray is a scrupulous editor. If we did not know that, there would be disbelief that any American appliance manufacturer said that—and more.

'We believe,' Mr. Maytag's quote continues, 'that progress involves change, but that change alone does not necessarily involve progress.'

At mid-year, there were 487 gas undertakings, across America, that are municipally-owned. The extent of this trend is suggested by a comparison with 1945, when the total was 86.

American Gas Association is aware—actively—of the creeping encroachment by the municipalities. A specialised programme maintains a flow of information to gas industry employees, the financial world and the general public —to tell the full story of the benefits to all in shareholder-owned companies.

Of the total 487 municipally-owned undertakings, 337 have annual gross revenues in excess of £8,925. The 337 account for a total of 1,782,778 customers, out of the national total for all undertakings, 29,536,600.

Currently, there are municipal gas operations in 34 of the 48 states, with no indication of preference in any specific area. The municipals are credited with 5.4% of the total gas undertakings' revenues. That percentage amounts to £73,921,784.

One analyst claims that the idea of municipal ownership most often has been 'promoted by a combination of bond

(Continued overleaf)

houses and engineering firms who profit by financing and engineering fees.'

Another gas operated air conditioner has been announced to help fill the deep summer valleys in the undertakings' sendout curves. This one is of the absorption type and is designed for installation with gas-fired central heating systems to convert them to all-year operation.

How much does gas service from the undertaking cost the American consumer?

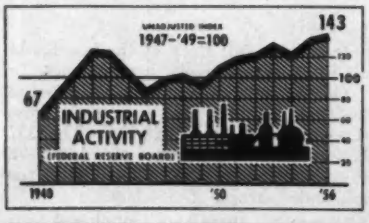
U.S. Bureau of Labour Statistics collects monthly data on gas, together with other items making up the consumers' price index. A national average would not be a meaningful answer to the question, so here are monthly residential bills, for September, in six scattered cities:

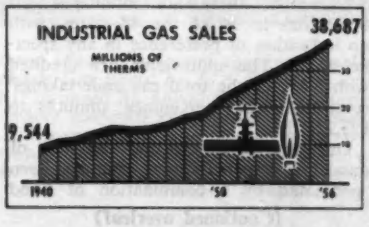
	Heating service	Non-heating service	
	100 therms	10 therms	25 therms
	£ s. d.	£ s. d.	£ s. d.
Detroit	2 17 11	12 3	1 2½
Houston	2 0 11	12 7½	18 10¾
Los Angeles	2 2 0	12 1½	18 10
Pittsburgh	2 3 6½	11 5½	17 8½
San Francisco	1 15 1½	8 10½	14 4
Washington, D.C.	4 8 6½	13 5¼	1 9 9½

Contracts awarded for building throughout America during the first nine months had a total valuation increase of 12% over the same period last year. Residential building contracts, up 19%, amounted to £342,561,424. The non-residential contracts increased 4% to a total of £280,901,425.

Costs of building construction, as measured by F. W. Dodge Corporation, construction news and marketing specialists, went up 3% during the 12 months through September. The rise since 1941 amounts to 148%.

Industrial gas sales by American undertakings increased three times faster in 1956 than the nation's overall industrial activity, American Gas Association found in a recently-completed comparison. With the 1947-49 level as 100% for the overall activity, the 1956 level was up 2.9%. From the 1940 level, industrial gas sales climbed 9.4%. This A.G.A. analysis does not include the huge volumes of gas sold to industrial customers directly from the transmission pipelines.





Mr. E. J. Boothby, President, Washington Gas Light Company, and an elder-statesman of the American industry, has been re-elected Chairman of the Board of Trustees of the Institute of Gas Technology. The Institute, affiliated with the Illinois Institute of Technology, was visited by members of the British delegation to the International Gas Union conference in New York, during 1955.

The I.G.T. Director, Dr. Martin A. Elliott, has just announced that the volume of sponsored research expanded at the Institute to more than £235,713, for the fiscal year of 1956-57.

I.G.T. inaugurated a four-year undergraduate scholarship programme and now has developed a curriculum leading to the degree of Master of Science in gas engineering. Also, approval has been given to a programme leading to the degree of Doctor of Philosophy.

Basic research programmes at I.G.T. include physical properties of gases, new techniques for gas analysis, gas-making reactions, combustion and applications of nuclear science. The sponsored research programmes consider gas transmission and distribution problems, production of high-B.Th.U. gas from coal and oil, peak-load processes, catalyst research, petrochemicals and utilisation research.

A gas refrigerator for the American industry is still a matter of some concern. One industry source insists the potential is worth determined effort. He pegs the total revenues from refrigerators now installed at approximately £21.5 mill.—and thereby counters another source, reported in September, who takes a dim view of the refrigerator's importance to the industry.

In a real switch, a Los Angeles appliance distributor announced last month that the gas refrigerator will be back on the market in January, with a full line of boxes manufactured by Krefft of Dusseldorf, Germany. The largest, 11 cu.ft., will be priced close to £142. That is £35 lower than the last price for the comparable box sold by Servel, Inc., before they made their final and crea-ing bows to the industry.

Despite that announcement, it is known generally that American Gas Association is continuing the discussions with five large home appliance manufacturers to encourage their interest in the gas refrigerator.

Some indications point to the possibility of more than one manufacturer getting into the gas business. That might well prove to be just what the refrigerator needs—the competitive considerations of appliance development and selling.

El Paso Natural Gas Company, the largest gas company in the world as a result of the acquisition of more than 99% of the shares in Pacific Northwest Pipe Line Corporation, has lost a motion in the anti-trust suit instituted by the U.S. Department of Justice. The Company is expected to appeal the decision of a U.S. District Court. The Department has indicated it will proceed to trial with the case.

Canada

Govt. Research Lab. Announce New Process

THE research laboratory of the Ontario Government claims the development of a new process for smelting low-grade iron ore at favourable economic levels, using natural gas from Trans-Canada Pipe Lines as the fuel. The process, owned by the provincial government, is described as requiring the total through-put of the gas lines, at six smelting plants. One is impelled to ask *the rate* at which the gas would be sold, in view of the long haul across the Dominion in a high-cost transmission pipeline.

B. C. Electric Company blasted 48 gas ovens as the dramatic termination of coal gasworks in Vancouver.

Pacific Petroleums Ltd., reports that one of its wildcat wells in Alberta tested at the 6,900 ft. level, showed a flow of 2.5 mill. cu.ft. daily. The well is still drilling on its way to the objective, the Mississippian sands at approximately the 10,000 ft. level.

Natural gas service to the Ottawa district is anticipated during December. A 36-mile spur line from Trans-Canada Pipe Lines on the Toronto-Montreal extension will deliver the gas.

A Canadian independent oil producer, Home Oil Company, has purchased 85,00)

shares of Trans-Canada Pipe Lines directly from Tennessee Gas Transmission Company, an American pipeline system. Reports indicate that Home Oil had previously-large holdings in Trans-Canada.

The pace of gas activities in Canada for the future is forecast by recent company announcements of 'doubling' present facilities. Mr. Frank McMahon, President of Westcoast Transmission Co., Ltd., and Mr. A. P. Craig, Vice-President of Trans-Canada Pipe Lines, Ltd., made those announcements on separate occasions recently. In both instances, the expressions of confidence were made in face of the Prime Minister's views on exports.

Winnipeg and Central Gas Company, Manitoba, was host to the public at a hamburger party as part of the celebration that marked the starting of natural gas service. The Premier, Mr. Douglas L. Campbell, turned on a huge gas flame as the official arrival of the new fuel. The gas undertaking had a total of 146 miles of main in 1954. Preparing for the new service, it added 100 miles and put 6,000 new customers on the books.

The fat—financial fat—of Trans-Canada Pipe Lines Limited is now in a very hot fire. The trigger was the plan of a proposed American pipeline project to take 200 mill. cu.ft. per day from Trans-Canada for delivery to U.S. markets. But, there is more to it. Gas projects on this side of the Atlantic have a way of becoming less-than-simple to understand—and describe.

Trans-Canada's financial underwriting has been largely by American investment bankers. Privately, American gas spokesmen point to the enmity built up by Canadians against 'Texas oil millionaires' who, it is claimed, have gained too great a control of Canadian resources and related facilities.

With the complexities that make up these considerations, the new Canadian Prime Minister suggested, from the Parliament floor on October 31, that no new Canadian gas export permits should be granted until there had been full study of the report of the Royal Commission of Investigation on energy. That report may not be forthcoming for a year or two.

Following that statement, there was wide uncertainty about the validity of the commitment by the previous Minister of Trade and Commerce in a letter to Trans-Canada indicating authorisation of gas export to the American project. There has been no official Canadian assurance that the Trans-Canada export scheme is exempt from the Prime Minister's 'suggestion.'

The Royal Commission's investigation was described by *The Christian Science Monitor* as meaning that Canada was 'getting ready to take a long, hard look at the export of natural gas, oil and hydro-electric power to the U.S.'

Of the associated American project, Mr. Gene Smith wrote in *The New York Times*, 'No export agreement, no financing.' And, it may be added, 'No export agreement, no American project.'

Editorial note: Certainly all Canadian resources should be safeguarded against export to the point of depleting them at the expense of prospective or even potential domestic utilisation in the foreseeable future. It is in the mutual best interests of Canada, America, Great Britain and all the Western World, that Canada's resources be applied to present and anticipated technologies within its borders. That consideration ignores, purposely and pointedly, what might be the best interests of the 'Texas millionaires.'

Is it, however, really in the best interests of Canada to block the export of gas in a terminal manner?

The already-proved natural gas reserves in the Dominion are tremendous. Geologists agree that individual fields have not been explored to their limits. They agree, also, that technical indications point to new and promising areas for exploration.

It is basic that non-production of gas is not resource conservation, if there is economic market-demand for that gas. Blocking exports will make mandatory, under Canada's commendable gas conservation laws, appropriate measures to avoid wasting gas produced in association with oil. The alternatives are 'shutting in' gas-producing oil wells or recycling the gas to the subsurface producing levels. Either way, substantial royalties that would accrue to Canada are blocked together with the gas. Also, there is, in the case of Trans-Canada, the importance of load-factor in export gas for a pipeline that has very high construction, operating and carrying costs. Operation at high annual load-factor serves the economic interests of Canadian customers of the line.

As a heartfelt greeting—Merry Christmas . . . a thoroughly Happy and Peaceful 1958!—H. H. C.

The Kowloon Pipeline

THE idea of transporting bulk liquids and gases by submarine pipeline is novel, but not new; many previous attempts had been made—with generally unsatisfactory results. Pipelines laid along the river bed expose themselves to the ravages of nature and become encrusted with parasitic marine life and even eaten away by it. The bulk of the pipe interferes with silt flowing to the sea, causing dangerous shoals; anchors can foul them and generally they become navigational hazards, as well as dubious investments. Authorities have preferred to make detours—sometimes long detours—to take pipes over existing bridges or natural fords. Expenses in such cases are often fantastic.

Land & Marine Contractors, Ltd., established a precedent in this country when they laid twin gas mains, which are fully protected against corrosion, under the River Usk at Newport, in a prepared trench which was later back filled—a skilful operation in view of the 48 ft. tides encountered.

The Newport achievement was closely followed by tasks of like nature in other parts of the country including an enquiry from the Hong Kong and China Gas Company.

Sales of gas on the island of Hong Kong have reached such proportions that it became imperative to consider extending the capacity of the West Point works. This old plant, however, is already so heavily congested that further extension is most undesirable and the only real alternative is a trans-harbour main from Kowloon. By laying a gas mains connection from the Ma Tan Kok works on Kowloon to Hong Kong and stepping up production, the original West Point plant can be inevitably closed down.

On the strength of the report sent back by the Chief Engineer of Land & Marine, a specially equipped team flew out to Hong Kong with echo sounding apparatus to make an hydrographic survey of the harbour bed and a detailed examination of the shore line. Final reports were despatched to England. At Bromborough, Land & Marine draughtsmen drew up plans for embedding twin 10-in. diameter pipelines under Kowloon Harbour. Now work has started on a £200,000 project. The mains must be laid by March next year and the whole job completed before the monsoons in May.

Already bitumen covered pipe sections, equivalent to twin mains each 5,200 ft. in length, have been obtained and shipped out of Birkenhead. A 28-ton winch will follow very shortly, together with much specialised equipment. At Hong Kong the pipe sections will be assembled on a prepared launching bed and bended to the contour recommended by the hydrographic survey.

Meanwhile, a trench, 8 ft. deep and nearly 80 ft. wide is being systematically dug and prepared through the harbour bed by a dredger, from Hong Kong to Kowloon. The gas pipes, assembled in two sections, will then be hauled by the big winch through the trench from shore to shore. Pontoons attached to the ends of the pipes will help the movement and also keep the ends free from unseen obstacles. This ponderous yet delicate operation completed, divers will make a final underwater examination.

Finally, the gas mains connecting the Ma Tan Kok works at Kowloon with Hong Kong will be completely buried in the harbour bed.

Characteristics and Uses of Fuel Oils

by

A. R. MYHILL, F.R.I.C.

OILS used as fuels, including those used indirectly, as when utilised for the production of fuel gases, may be classified into two groups: (1) Petroleum oils; (2) coal-tar oils.

(1) Petroleum Oils

Crude petroleum is found naturally in many parts of the world, notably the Middle East and North, Central, and South America. The amount of natural oil found in this country is negligible, but there is a petroleum refining industry of considerable, and increasing magnitude, now treating about 30 mill. tons of crude oil per year, mainly from Middle East sources.

(a) Occurrence of Oil in the Earth

The diagram below shows a typical section of an oil field.

It will be seen that, in the oil well itself, or in its immediate proximity, besides oil there are accumulations of water and gas and for successful working provision must be made for tapping off these components, relatively free from the other products of the well.

The oil is consumed by the anticlinal, or hump-backed nature of the limestone stratum in which petroleum was formed by the bio-chemical changes in deposited organic matter originally collected in a lagoon, where, over geologically long periods, hydrocarbons, which are the essential constituents of mineral oil, were formed by chemical-bacterial actions involving loss of oxygenated components, as carbon dioxide. Where the strata-formation has become folded by volcanic action and subsidence, particularly where sections have become covered by an impermeable rock layer (cap-rock), the gas and oil will be prevented from escaping, and these products can then be released under considerable natural pressure by making borings into the appropriate layers. At the top of the 'dome' is gas, so that a well drilled down to this level strikes gas only. The gas consists almost entirely of hydrocarbons, but varies in composition very considerably according to the location of the well. The hydrocarbons are not difficult to liquefy under pressure, and a well yielding a high proportion of easily liquefiable gas is sometimes known as a 'wet' well.

The following table shows typical 'wet' and 'dry' gas compositions. The wet gas, containing a preponderance of butanes is useful as a 'bottled' gas, for portable use, while the dry gas, consisting mainly of methane, is not of such high calorific value, but is more suitable for distribution as domestic and industrial piped gas, since it is not so liable to fractionate and partly condense in the mains.

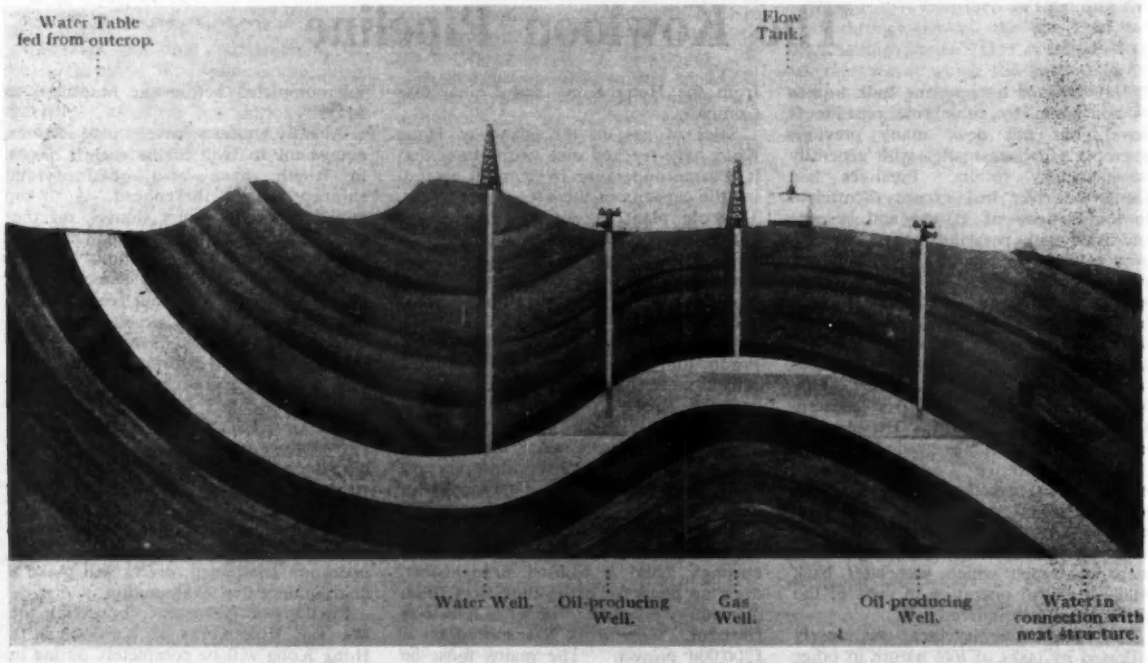
NATURAL GASES

	'Dry' gas (*Pittsburgh*)	'Wet' gas (*West Virginia*)
Specific Gravity (Air = 1)	0.65	1.38
% by Volume :—		
Carbon Dioxide CO_2 ..	nil	nil
Methane CH_4	84.7	18.0
Ethane C_2H_6	9.4	nil
Propane C_3H_8	3.0	nil
Butanes C_4H_{10}	1.3	78.7
Nitrogen N_2	1.6	3.3
Hydrogen Sulphide H_2S..	traces	traces

A well which is drilled below the gas level but above the water level will yield oil. Lower down, drillings will bring up water. Various geophysical methods and apparatus are used in preliminary surveying, for example, those utilising the reflections of explosion waves sent from the surface and back to the surface, but the ultimate test is by drilling.

(b) Composition and Characteristics of Petroleum Oils

Crude oil as shipped to this country is a mixture of very



Diagrammatic representation of a typical section of an oilfield.

variable composition, consisting of a large number of chemical compounds, almost all of which are hydrocarbons. The composition of the oil and its chemical properties are characteristic of its source of origin. It varies in consistency from a mobile liquid to a substance as viscous as treacle, and the colour may range from light yellow, through various shades of brown or green, to black. Although its chemical composition is so complex and variable, the products obtainable from it are marketed in a comparatively small number of classes, based mainly on physical characteristics.

Large quantities of pure chemicals are also made from oil products, but the main consumption is for fuel (including power) and lubrication purposes.

The commercial classification of petroleum products is based primarily on their average boiling point range and, in effect, the refineries separate crude oil by distillation into the following classes. These are listed in ascending sequence of average boiling points, and, in general this applies also to their specific gravities and viscosities.

A. Motor spirits.
B. Solvent spirits (turpentine substitutes, etc.).
C. Paraffin, kerosene and burning oils for lamps.
D. Gas oils and diesel oils.
E. Lubricating oils.
F. Solid paraffin waxes, pitches, tars, and 'residual oil.'

From the point of view of fuel technology, the important products are the motor spirits, which have low boiling points and low flash points, the kerosenes, having flash points well above normal atmospheric temperatures, gas and diesel oils, and residual oil.

Gas oils and diesel oils are generally so similar in characteristics that they are interchangeable in their respective uses. In many cases, although sometimes marketed under separate names, these two products are identical. Where there is a difference, it is usually in the somewhat higher proportion of paraffin hydrocarbons of the C_nH_{2n+2} series in gas oils, since these substances are readily 'cracked' in the gas-making processes, whereas for diesel engines, or simple furnace firing, the chemical composition is often not so important.

Although the separation of crude oil fractions into classes is primarily based on distillation, modern refinery practice now includes other techniques which include thermal and catalytic 'cracking.' This involves heating the liquid or its vapour to such temperatures, either with, or without a catalyst, and at various pressures, that the molecules of the hydrocarbons become split up in such a way as to form other, and more desirable hydrocarbons, often with the co-formation of hydrogen and/or free carbon. By these means, the characteristics of the original fractions can be completely altered. Refinery technology has, in fact, now reached such an advanced stage that a demand for any product in temporarily short supply can often be met by suitable treatment of another fraction. As an example, although motor spirits are generally obtainable from the low-boiling constituents of crude oil, large quantities are also made by cracking the heavier fractions hitherto considered unsuitable. The demand for a particular class of oil will, therefore, affect the capacity of the refinery in the production of other classes.

Although it is true, in the widest sense, to say that all classes of oil can be used as fuels, since they are all readily combustible, it is now customary to employ the term 'fuel oil' to residual oil, *i.e.*,—to that part of the crude oil having the highest average boiling point and viscosity, which is left behind in the still after the more readily vapourisable constituents have been driven off by distillation. In some cases, however, the term is rather loosely used, and the student is warned to confirm, in particular cases, that this definition is implied when studying or discussing statistical data, etc. For instance, oil of the gas-oil range is sometimes called 'fuel oil.'

(2) Coal Tar Oils

Coal tar oils are not used as fuels to the extent to which petroleum products are employed. There is the advantage however that, in this country, such fuels are prepared from indigenous material (coal), so that in this matter we are independent of foreign sources and foreign currency.

Coal tar is produced as an important by-product by the carbonisation of coal at gasworks and coking plants. The amount produced varies considerably with the type of carbonising plant but on the average is about 10 gal. per ton of coal carbonised. The extent to which crude tar is distilled is governed by varying market requirements, particularly for the heavier products such as the coal tar fuels. When a coal tar fuel is used for industrial heating purposes, as, for example, for boiler firing or furnace work, it is necessary to use atomising burners and sprays, and the ability to employ this type of apparatus will depend largely on the viscosity of the fuel at the particular temperature at which it is fed to the atomiser. Thus, where a distillate of comparatively low boiling point range is employed, this will generally be a thin, mobile oil, which can be pumped and atomised at ordinary temperatures. As the boiling point range of the fuel increases, however, its viscosity at ordinary temperatures becomes much higher, so that direct use at such temperatures would be impossible. It is therefore necessary to provide means for heating such fuel before it can be pumped or atomised, and the supply tank and service pipes have to be lagged to prevent loss of heat. The Association of Tar Distillers has classified coal tar fuels into six grades, known respectively as C.T.F. 50, 100, 200, 250, 300 and 400. These figures represent approximately the temperature in degrees Fahrenheit at which the particular fuel is in a condition suitable for atomisation.

Polymerisation

As in the case of petroleum distillation, the low-boiling fractions are mobile liquids, including benzene, toluene, xylene, etc., and, with increasing boiling point range, the liquid becomes more viscous and darker in colour. The increase in viscosity and deepening in colour are due in a great degree to polymerisation which takes place on account of increased temperatures during boiling. This results in the aggregation of simple molecules, particularly of the unsaturated classes, into more complex molecules, often containing the same proportion of hydrogen and carbon atoms, but having a much greater number of atoms in the molecule. Such compounds are of high viscosity and often dark in colour. In addition, free carbon may be produced in the course of the reactions.

Creosote, or creosote oil, used largely for burning under boilers or for furnace work, is derived from several fractions in the middle boiling ranges. Its composition as a commercial product is very variable, since it often contains tar oils of different sources of origin, in fact it is a common practice at tar distilleries to mix products of comparatively low chemical value with the creosote oil in order to find a market. As a rule, the incorporation of such extraneous substances does no harm to the use of the mixture for fuel purposes, since their calorific value is high. It is essential, however, to ensure that correct temperatures are maintained for its distribution and atomisation, since naphthalene and other solid hydrocarbons may be in solution, and these would tend to crystallise out if temperatures were not kept sufficiently high.

Specialised Technique

As a general rule, any fuel-oil system which is fitted with tank heaters and pipe heaters can be used for burning C.T.F. 50 or C.T.F. 100. Heating may be by steam or electric heating cable. With C.T.F. above 100, rather specialised technique is called for, and the best arrangement is to circulate the fuel, by pumping, from the storage tank through a ring main past the burners, and back to the tank. Heating of the ring main is by steam, the temperature being controlled by the pressure available. Local boosting of temperature is often employed by using electric heating. Temperature and pressure stabilisation throughout the piping system is ensured by maintaining a copious flow, at least 2½ times the fuel consumption being circulated through the ring main.

Changing-over from tar-oil firing to petroleum oil firing at short notice is a not uncommon practice, often resorted to on account of price and availability considerations.

It is important to note in this connection that the two types of oil should not during the change-over be stored together in the same receptacles or allowed to mix for any considerable length of time in the pipes, pumps, or atomisers, since chemical action may take place between the compounds present in the two oils, with the result that a troublesome deposit may be formed, varying in consistency between a jelly or emulsion and actual solid particles. On this account, before changing over the fuel, the reserve stocks should be worked down to

the lowest volumes, and all drains, sumps, etc., opened to clear the system. It is often necessary to steam out the whole layout before introducing the new oil.

Tests and Specifications for Fuel Oils

Where fuel oil of petroleum origin is bought for use in large quantities, it is usual to buy to specification, which can be arranged to cover the characteristics with a greater or lesser degree of completeness, according to the use to which the oil is intended to be put. Specifications for coal tar fuel are not, as a rule framed in so much detail, since its use is more restricted, and, provided the C.T.F. number (which is determined by its viscosity) is maintained between fairly close limits suited to the plant consuming the material, it is rarely necessary to specify further than this.

The following criteria are among those usually considered desirable to specify in the case of petroleum products:

(a) **Viscosity.** This is probably the most important characteristic of fuel oils. In practice, its determination is carried out by measuring the time in seconds taken for a known volume to pass through a standard jet under specified conditions of temperature and gravitational head. In this country the Redwood Viscometer is used as the standard apparatus, 50 millilitres of oil being used at a given temperature. The temperature is specified in the contract for purchase, and will vary greatly with different grades of oil, since viscosities differ from a mobile liquid passing through the orifice in a few seconds, to a very thick, almost semi-solid material taking several hours to pass through the same orifice at the same temperature. On this account specified temperatures may range from, say, 40°F. to 300°F. according to the oil. Redwood's viscometer, moreover, is made in two forms, No. 1 and No. 2, and the form used must be specified. No. 1 is used for oils which, at the temperature of the test does not exceed 2,000 seconds, while No. 2, having a larger orifice, is used for those oils which take more than 2,000 seconds (or in some cases 1,000 seconds) to pass through the orifice.

(b) **Specific Gravity.** This is defined as the ratio of the mass of a given oil to that of an equal volume of water at 60°F., and is determined either by hydrometer, pyknometer, or other direct weighing method. Its significance lies in the determination of volumes of storage capacity required, and in calculating volumes to weights or vice versa. Since the calorific values, on the weight basis, between the various oil fractions are approximately constant, it follows that the higher the specific gravity, the greater will be the heating value in B.Th.U. per gal.

(c) **Calorific Value.** This is determined by means of the bomb calorimeter. The direct determination by this method gives the *gross* value, but since oil-burning furnaces, in common with other industrial furnaces, evolve the products of combustion at a temperature above the condensation point of water vapour, it is the *nett* value which is of significance. A determination of the hydrogen content of the oil will therefore be necessary in order to arrive at the value required.

(d) **Flash Point.** This is the temperature, usually expressed in this country in degrees Fahrenheit, at which the air space above the oil under standard conditions contains sufficient oil vapour to be ignited by a flame. All of the light hydrocarbon fuels of the motor spirit type have flash points below ordinary atmospheric temperature; that is to say, a naked light will immediately ignite the liquid without a wick, and, in an enclosed space the ignition would take place explosively, usually with considerable danger.

Legal Restrictions

The flash point of such liquids is not determined as a routine commercial test, but, since it is necessary to avoid fire and explosion risks with heavier oil fuels, it is necessary to know the flash point of fuel oil. There are certain legal restrictions on the storage and transport of oils in relation to their flash point, and these must be complied with. In this country, determinations may be made by the 'open' or 'closed' methods of testing, according to specification. For the closed flash point, in which the oil is slowly heated in a covered cup with a removable top slide for applying the testing flame, the Abel instrument is used for F.P.'s below 120°F., and the Pensky-Martens instrument is used for F.P.'s above this figure.

The latter instrument also allows of the carrying out of a 'fire-point' test, in which the temperature (above flash point) is determined at which the oil has to be heated in order to burn continuously, on application of a flame, for five seconds. In this case, modifications in the instrument are incorporated for determining the 'open' flash point.

(e) **Pour Point.** The pour point is the lowest temperature at which the oil will flow when chilled under prescribed conditions. If the oil contains wax, anomalous results may be found. For this reason, previous heat treatment is specified, although actual flow behaviour through pipes is predictable from the pour point, only in conjunction with the viscosity of the oil at the relevant temperature.

(f) **Carbon Residue.** Carbon may be, and usually is, to a greater or less degree, produced by the combustion or 'cracking' of oil. The amount produced in cracking as, for example, when the oil is used for making gas, may be quite large in quantity in the case of some oils, but the amounts formed when oil is used directly as a fuel, *i.e.*,—when burnt in air, should be very small, since plant and technique should be designed to ensure complete combustion. The test applied for carbon residue, carried out under specified conditions, will give some idea of the relative carbon-forming propensities of the oil. The Conradson carbon test (or 'coking' test) consists of heating the oil by a gas flame in a prescribed manner, the liquid being contained in a crucible, standing in another crucible and surrounded by a hood. When heated in the manner prescribed, the carbon residue is weighed and expressed as a percentage by weight of the oil. A later method, the Ramsbottom test is considered to give more reproducible results, although results from the two methods will be different and cannot be quantitatively compared. This latter test employs a glass bulb instead of a crucible.

(g) **Rational Analysis.** Oils used for gas-making belonging to the middle fractions obtained from crude petroleum consist of a mixture of hydrocarbons classifiable into the following four groups:—

(a) Paraffins, having the general formula C_nH_{n+2},
(b) Unsaturated hydrocarbons of the olefine type, having the general formula C_nH_{2n} the atoms being arranged in chain form in the molecule with double or treble bonds.
(c) Naphthenes (or cyclic paraffins) having the general formula C_nH_{2n}, the atoms being arranged in general with single bonds to form closed ring molecules.
(d) Aromatics, with molecular structures based on the benzene closed ring form, containing one or more rings with single and double bondings.

Accurate determination of all or of any considerable number of definite compounds in oil is very difficult and would require a long time to carry out, in fact it is, in practice, virtually impossible. A test has been devised, however, by which it is possible to determine with reasonable accuracy the proportions of the four classes of compound as given above. This is described in Appendix D, British Standard Specification 1784: 1951 'Test Code for Carburetted Water Gas Plant.'

Criterion of Abilities

The significance of the test is that it provides a criterion of the gas-making abilities of the oil. The order of ease of cracking, which determines volumes of gas to be expected from an oil-gas plant (including carburetted water gas-making) is as follows:

Highest	Paraffins
↓	Olefines
	Naphthenes
Lowest	Aromatics

An oil, therefore, containing a high proportion of paraffins and olefines, would therefore be expected to give higher gas yield on cracking than one in which the aromatics and naphthenes predominated.

For details of specified tests for fuel oils, the student is recommended to consult:

(1) 'Standard Methods for Testing Petroleum and its Products,' published by the Institute of Petroleum.

(2) British Standard Specification No. 209:1937 'Fuel Oils for Diesel Engines.'

(3) British Standard Specification No. 742:1937 'Fuel Oils for Burners.'

Getting Going on Work Study — 3

This is the third of a series of three articles specially contributed to the 'GAS JOURNAL' with the idea of stimulating interest in the use of Work Study. The first article considered the possibility of setting up a Central Work Study Authority under the Gas Council; while the second dealt with the advantages as well as the problems likely to be brought about at management level.

SOONER or later in any discussion on Work Study the controversial subject of Union attitudes will arise. Some people take the view that one should not, therefore, discuss it; and this ostrich-like behaviour leads from time to time to apparently inexplicable explosions. Others, like Dr. Pangloss, tend to speak or write as though the controversy does not exist; often they take this attitude out of goodwill, and therefore they are deeply hurt when differences appear. We might remind ourselves at this point of the way in which Work Study gets at the facts about a situation and enables us to demonstrate the true nature of a problem. No industry practising Work Study widely would pretend that every application goes in without friction. But few of them will deny that negotiation runs more smoothly when people know precisely what it is they are negotiating about; where the management comes with precise proposals, and the employee representatives understand what management is talking about, relevant and highly vexed questions outside the scope of a negotiating committee tend to be eliminated and, consequently, heat is not so quickly developed if at all.

This is a clear benefit to the employees affected. Contributing to benefit the management side is the resolve to give the fullest possible information, and to consult freely as part of the normal procedure of a Work Study application. On the shop steward side, the need has been recognised for some years for ensuring that Union officials at all levels have some pretty intensive appreciation and practical training in Work Study. The subject looms large in the training programmes at the T.U.C. headquarters in Bloomsbury, where the Production Department runs its own courses. Individual unions—including those covering engineering, boot and shoe manufacture, printing and book binding, to name but a few—have either run special shop steward courses or appointed trained full-time officials to advise on the specialist techniques. I have mentioned these matters solely to demonstrate the value of narrowing down the area of difference between management and employees to cover those areas of activity over which management and employees, each in their own way, have some degree of control.

Saving Lost Time

The result of this mutually receptive attitude in one large industry has been a record of time lost in disputes only 1/7th of the national average. Only rarely do questions of local application 'blow-up' on the national level. On the other hand a certain national board which has embraced Work Study at the top has found recently that it was rejected by the Unions in one locality; which all goes to prove the importance of human skills, as well as frank and open attitudes, to those who are involved in the day-to-day discussion of Work Study on the *ad hoc* local scale.

Even questions regarded as national ones have been in great measure dealt with through proper consultation. This is not perhaps the place to indulge in pious forecasts about the inevitability of full employment so long as people are willing to change their jobs. It is true that instead of becoming a nation of starving blacksmiths, Great Britain has instead become one of the foremost motor manufacturing nations of the world. The ordinary man does not, however, find that his short-term worries disappear in the contemplation of an age of plenty.

But there are several answers to the fear of redundancy. One is an effort on management's part to answer or to stimulate rising demands calling for more production. Another is to develop new products and services and find alternative work within the same firm. Numbers of firms allow 'natural wastage' to look after redundancy, in some cases before applying the results of Work Study to a particular department or shop. Certainly nobody would continue to recruit while there was a possibility of using one's own 'timber.'

That sensible and acceptable plans to cover the possibility of redundancy can be made, the experience of one large firm bears out. Within just over a year of initiating the Works Study campaign, this firm had a joint meeting with the Unions signatory to its agreements, to discuss certain aspects of the subject. The discussions were carried out with infinite patience for nearly 12 months. The result was an extensive agreement accepting the general principles of Work Study and, in particular, a number of agreed safeguards—the only reservation being that constituent Unions reserved the right to negotiate on matters which might contravene their separate constitutions or national policies.

Test of Union-management Relations

The introduction of Work Study is indeed a test of Union-management relations. If a firm has a good history in this field, there is no reason to expect that it will have trouble when Work Study is mooted. In any case let us not overlook the positive improvement in relationships that is very often one of the hidden dividends of Work Study application. Summing up the benefits after three years of Work Study application, one medium-sized company came to the conclusion that it improved relationships with Trade Unions because: (1) Individuals matter more, (2) frustrations due to waiting for jobs or materials are diminished, (3) work measurement eliminates injustices caused by guesswork, and (4) the level of earnings is at least maintained with less overtime and consequently more leisure.

It is, perhaps, prejudicing the issue for me to quote these typical reactions before discussing what benefits Work Study can bring to the individual employee; for the Unions themselves would be the first to agree that they deal substantially with wages and hours, and concern themselves only in a general way with individual satisfaction.

In order to consider what satisfactions can be added to the working day as a result of 'organised commonsense' we might consider what it is that the average man wants out of his job. There have been quite a number of researches into this matter, and they have been summarised by an American sociologist as follows: (1) The society and respect of other people, (2) the degree of creature comforts and economic security possessed by the most favoured of his customary associates, (3) independence in and control over his own affairs, (4) understanding of the forces and factors at work in his world, and (5) integrity.

Let us take these goals one by one and see in what way Work Study can contribute to their realisation.

1. *The society and respect of other people.* One can hardly avoid the society of other people, but unless one is seen to be doing one's share it is comparatively easy to forfeit their respect. A man whose job is pointless, involving a great deal of standing around apparently doing nothing, is not likely to enjoy the good opinion of his fellows. By making sure that a man works effectively, without waiting for instructions, materials, tools and so on, Work Study contributes to his self-respect. Furthermore, by ensuring that the load is adequately shared between members of a team (which efficiency demands anyhow) it provides a basis for decent relationships.

2. *The degree of creature comforts and economic security possessed by the most favoured of his customary associates.* Above a minimum standard of living people have an expected higher level which they hope to achieve during their lifetime. The average worker does not expect, or for that matter want, a life like that of a Hollywood film star; but he does want to live as well as the man who is best off in his own sphere—let us say the best-off man in the 'local.' From a practical point of view the key to the achievement of this goal lies in the pay packet. Incentive schemes based on Work Study provide the best means for rewarding a man according to his effort: Which means that he is able, himself, to influence the degree to which he approaches the standard of living which he has in mind. That employees respond to this is proved by case after case of increased productivity resulting from the method improvement and accurate knowledge of results arising from applied Work Study.

3. *Independence in and control over his own affairs.* It is fairly well authenticated that one of the effects of Work Study is that a man becomes manager of his own machine or his own job. Very few top managers have the good fortune to be able to say exactly what their job is. Once a job has been work studied, however, it is possible for the man who is going to do it to understand clearly what he is supposed to do. This ensures that he is given adequate briefing and, if necessary, training in order to be able to do it. If he is paid on an incentive basis derived from work measurement—but only, of course, if the system by which his bonus is reported is comprehensible to him—he has a ready check on the success of his own piece of management. And if section or shop records are published (as they can very easily be when the work unit provides the common base) he has a means of comparison between his own success and that of others.

4. *Understanding of the forces and factors at work in his world.* From a practical point of view the attainment of this goal means keeping people in the picture. It does not necessarily mean telling them major policy. It is true that some firms make an effort to explain the financial position of the country to employees, but—setting aside the complicated language in which this effort is made—it is only natural that they should be primarily interested in having their own situation made clear. Where the exact object and procedures of a job have not been looked at analytically, and where the judgment of good or bad performance appears to depend very largely on personal opinion, there is not much room for understanding. One of the greater advantages of Work Study is that it finds out the facts. Another advantage is, of course, that Work Study cannot work unless these facts are given to the employees concerned. There is no use in management thinking out new methods or new performance levels or new incentive schemes in the privacy of an office, keeping them a secret. Just as the preparation for Work Study demands patience and full explanation and consultation so its effective application demands that the employee should be given full understanding of the proposals, particularly as they affect him individually. The proper training of Work Study Officers will, of course, include some insight into both the philosophy and the social skills involved.

5. *Integrity.* Not much need be said about this—most people like to feel that they are doing a good job and getting a just reward. Work Study helps define both of these essentials more precisely than other aids to scientific management. A man's feeling of integrity must depend in the last analysis on matching himself against some reasonably objective standard; for there is no security in a situation where one must rely on other people's prejudices and guesswork.

There are many other reasons why Work Study could be described as a service to employees. You will notice that from time to time in this article I have used the qualifying phrase 'Work Study *properly applied*.' For, excellent as the techniques are, we should never lose sight of the fact that while a technique is one thing, the way it is applied is another. A good deal of suspicion still exists about Work Study, based very largely on the mis-application of earlier techniques. The modern view is much broader and as I pointed out in the first of these articles it is a peculiarity of the British system of Work Study that it takes full account of the hopes and fears, the needs and desires of the people who do the work of the world. It is important that this attitude should not be lost sight of in devising an overall Work Study policy for the gas industry. One thing is certain: If those responsible can once secure an atmosphere of mutual trust between management and employees, the results both in material savings and improved morale will astonish them.

British Standard for Radiographic Examination

THE non-destructive examination of materials by means of X-rays and Gamma-rays has, during recent years, become an accepted feature of industrial testing practice. Hence the importance of this new British Standard, 'General recommendations for the radiographic examination of fusion-welded circumferential butt joints in steel pipes (B.S. 2910:1957)' which is based on radiographic techniques that are being and have been successfully used in industry.

Adoption of the recommendations will assist in securing unified practice. But the Foreword to the standard emphasises that the recommendations take the form of general guidance on the application of the various procedures at present being used. Specifically, the 45-page illustrated publication relates to the radiographic examination of fusion-welded circumferential butt joints in steel pipes in thicknesses up to 4 in. (101.6 mm.) using the single wall technique, or 2 in. (50.8 mm.) using the double wall technique. The recommendations assume the complete radiographic inspection of the welded seam; but they apply equally where only small sections, *e.g.* —spot checks and radiographs of repaired sections—are to be examined.

Since exposure of any part of the human body to X-rays or Gamma-rays can be highly injurious, the standard includes a 'protection' clause. One of the recommended precautions is 'measurement of the amount of radiation received by the worker'; and particulars are given of the source from which films may be obtained for this purpose.

The standard concludes with an appendix containing 'Explanatory notes on the techniques.' Among the ten subjects dealt with are: intensifying screens, tube voltage and exposure, processing and viewing.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London W.1. Price, 8s. 6d.

From a paper to the Institution of Gas Engineers (Manchester and District Section) November 8, 1957.

Conventional Dry Purification of Coal Gas at Minimum Cost

By C. R. HOLLINGSHEAD, Assoc.M.Inst.Gas E.,

GROUP CHIEF CHEMIST, NORTH WESTERN GAS BOARD, SOUTH LANCASHIRE GROUP.

THE first objective of purification is to provide gas for distribution with the H_2S concentration below the limit stipulated by the Ministry of Power, i.e., 1.6 ppm., and no system is worth considering if this is not obtained. This has always been borne in mind during our investigations into purifying at minimum cost.

During 1951 theoretically Graph A showed that with three foulings, the coal gas at the St. Helens works could be purified at a profit of 14s. for every 3.16 mill. cu.ft. made.

As No. 3 set, a new installation five boxes 40 ft. × 40 ft. was to commence work during the winter of 1951, it was decided to start immediately with three foulings, returning the oxide when emptied to the same box, and work the oxide to 54.2% sulphur content at 10% H_2O. By returning the part spent oxide to the same box until spent, it was anticipated that this would save money by eliminating costs for preparation of charges and redispersal of stocks. In fact, the only oxide on the ground would be new and spent.

To help the experiment a graph of purification procedure was planned 12 months in advance, and, as far as possible, the plan was adhered to. The ammonia concentration at the inlet to purifiers was kept at 5-10 grains per 100 cu.ft.

An outlet oxygen content of 0.4% to 0.5% was suggested, and this was not varied except when in difficulties, until 1955 when it was increased to the range 0.6% to 0.7%. (This is discussed later.) All oxide as charged was under technical supervision with regard to H_2O content and *p*H.

Closed steam heaters have been utilised to increase temperatures in boxes in conjunction with open steam to regulate dew point, and normally a temperature of 85°F. to 90°F. is maintained at the outlet of the first taker. H_2S tests are done daily in conjunction with pressures and oxygen concentration inlet and outlet at the purifiers. Gas and air flows are metered and read hourly and adjustments to air flow are made accordingly.

In a paper presented in 1931 Messrs. Clayton, Avery and Williams suggested that comparisons of purifiers could be expressed as the 'R' ratio,

$$\text{i.e. } \frac{\text{Cu. ft. of gas per hour}}{\text{Cu ft. of oxide in box}}$$

This could be a sound basis if all boxes contained the same depth of oxide, but when this figure is quoted without the depth of oxide in a box its significance is lost.

I feel that a true comparison can only be obtained using the empty box velocity

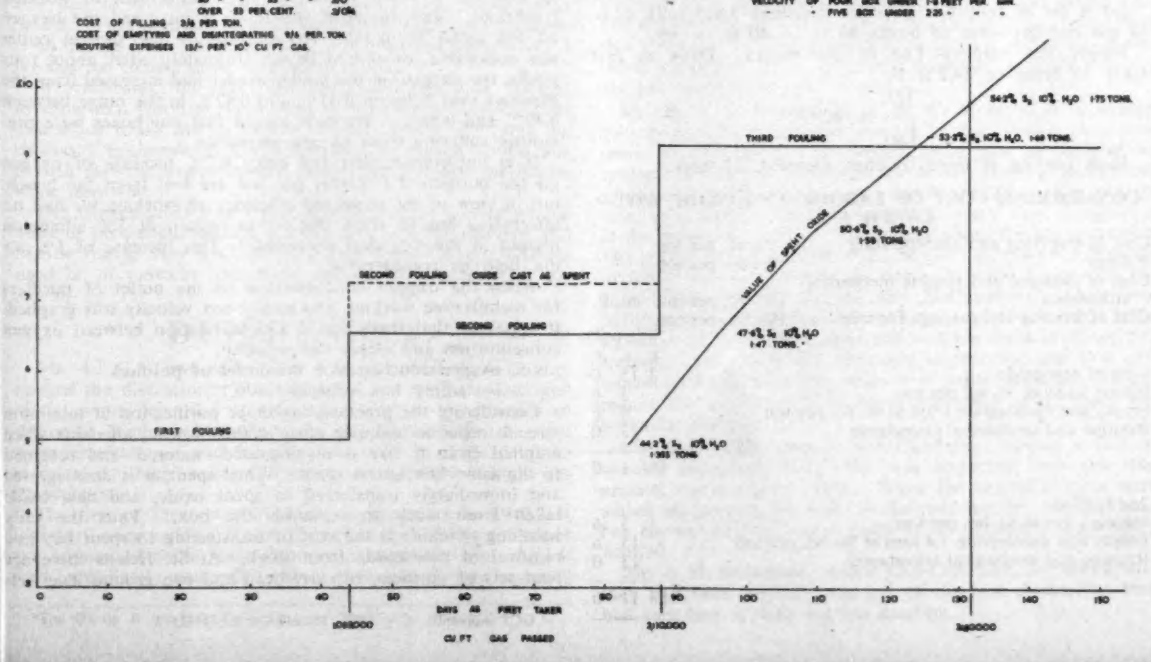
$$\frac{\text{Cu.ft. of gas per minute}}{\text{Area of box}}$$

and it is on this figure that all capacities of purifiers are related in the South Lancashire Group.

The ideal empty box velocity would appear to be approximately 1.8 ft. per minute for a four box set, with an increase of 25% for each additional box when a single layer of oxide is utilised.

The use of two layers of oxide in a box increases its capacity for H_2S removal and thus can deal with higher velocities, but costs are higher due to the increased number of grids used and the period of emptying and filling may also be prolonged. The vital factor in purification on high velocities is the speed

GRAPH A. 3 FOULINGS.


COST OF NEW OXIDE £3-15-0 PER TON.
VALUE OF SULPHUR, 44 PER CENT. – 46 PER CENT 1/8 UNIT PER TON
46 – – 48 – – 1/10½
48 – – 50 – – 1/11½
50 – – 52 – – 2/0
OVER 52 PER CENT. 2/0½
COST OF FILLING 2½ PER TON.
COST OF EMPTYING AND DISINTEGRATING 9/6 PER TON.
ROUTINE EXPENSES 6d/- PER 10⁶ CU FT GAS.
WEIGHT OF NEW OXIDE 45LBS/CU.FT. = 49·8 CU.FT./ TON.
DEPTH OF OXIDE 3'-0" AT FIRST FOULING
3'-6" – SECOND –
4'-0" – THIRD –
NEW OXIDE 38 PER CENT H_2O.
SPENT OXIDE 10 PER CENT. H_2O.
H_2S ABSORPTION 800 GRAINS/CU FT APPROX. 55 PER CENT. OF 580 GRAINS/100 CU FT.
EMPTY BOX VELOCITY 1 FOOT PER MIN.
VELOCITY OF FOUR BOX UNDER 1·8 FEET PER MIN.
– – FIVE BOX UNDER 2·25 – – –
£10
9
8
7
6
5
4
3
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
FIRST FOULING
SECOND FOULING
SECOND FOULING OXIDE CAST AS SPENT
THIRD FOULING
VALUE OF SPENT OXIDE
44·2% S, 10% H_2O 1·365 TONS.
47·6% S, 10% H_2O 1·47 TONS.
50·4% S, 10% H_2O 1·56 TONS.
53·2% S, 10% H_2O. 1·69 TONS.
54·2% S, 10% H_2O 1·75 TONS.
DAYS AS FIRST TAKER
CU FT GAS PASSED

of emptying the fouled box and its return as an active box in the system when filled.

Depth of oxide in a box is not proportional to its efficiency for H_2S removal, but the factor of safety is regarded as being at its highest when the maximum amount of oxide is charged to a box.

Thus an ideal thoughput for a four box set 40 ft. × 40 ft. single layer of oxide 3 ft. 0 in. deep

= 40 × 40 × 1.8 × 60 × 24 = 4.15 mill. cu.ft. per day.

Ideal throughput for a five box set 40 ft. × 40 ft. single layer of oxide 3 ft. 0 in. deep

= 40 × 40 × 2.25 × 60 × 24 = 5.18 mill. cu.ft. per day.

Ideal throughput for a six box set 40 ft. × 40 ft. single layer of oxide 3 ft. 0 in. deep

= 40 × 40 × 2.7 × 60 × 24 = 6.23 mill. cu.ft. per day.

Graph A is applicable for all boxes of the conventional type up to an empty box velocity of 1.8 ft. per minute for a four box set and 2.25 ft. per minute for a five box set. The oxide is fouled three times and results in 4 ft. 3 in. layer of spent oxide, having started with a 3 ft. layer of all new.

The graph correlates the cost of purifying gas against revenue obtained for spent oxide. The graph was compiled in 1951 and thus is based on wages, etc., at that time.

Where the two lines meet, purification is carried out at no cost. Our objective was to work to a sulphur figure at 54.2% thus making a profit of 14s. for every 3.16 mill. cu.ft. of gas made against a previous loss of 83s. (this is equal to 0.07d. per therm). On the left hand side of the graph plotted vertically is the cost in pounds. Along the base line is the volume of gas purified and the days as first taker. An empty box velocity of 1 ft. per minute was assumed in order to plot the graph.

The figure 132 on base line is a very interesting and important figure which enables a ready assessment of purification procedure to be made with confidence. It is the number of days as first taker with empty box velocity 1 ft. per minute for a sulphur content of 54.2%. This figure, when divided by the empty box velocity for any set, gives the number of first taker days required to bring the oxide up to 54.2% sulphur, and this figure divided by the number of foulings predicts the future working of a purification system when commencing with a 3 ft. layer of new oxide up to velocities previously stipulated.

Taking examples from the graph:—

(a) A works practises two foulings and sells oxide at 44.2% S_2. The loss would be 45s. for every 2 mill. cu.ft. of gas made, i.e., 22s. 6d. per mill. cu.ft. made. At St. Helens this would be £6,000 per annum. Expenditure of capital is justified to avoid this loss.

If this oxide was returned to box, and after the third fouling sold at 50.6% S_2, the loss would now be 22s. for every 2.66 mill. cu.ft. made, but if sold at 54.2% S_2 a profit of 14s. for every 3.160 mill. cu.ft. made would be the result.

(b) A set of four box purifiers—purifiers 3.825 mill. cu.ft. of gas per day—size of boxes 40 ft. × 40 ft. × 6ft.

Empty box velocity 1.66 ft. per minute. Days as first taker to bring to 54.2% S_2.

$$\frac{132}{1.66} = 80$$

Each fouling, if three foulings accepted, 27 days.

CONSIDERING COST OF LABOUR AND OXIDE ETC.—GRAPH A :—

Cost of emptying and disintegrating	9s. 6d. per ton
Filling	3s. 6d. per ton
Cost of cleaning and routine mechanical attendance	13s. 0d. per mill. cu. ft.
Cost of loading and carriage for sale	10s. 0d. per ton

	£	s.	d.
Cost of new oxide	3	15	0
Filling 1 ton at 3s. 6d. per ton		3	6
Empty and disintegrate 1 ton at 9s. 6d. per ton		9	6
Routine and mechanical attendance		13	0
	£5	1	0
2nd Fouling			
Filling 1 ton at 3s. 6d. per ton		3	6
Empty and disintegrate 1.4 tons at 9s. 6d. per ton		13	6
Routine and mechanical attendance		13	0
	£6	11	0
If sold, 1.4 tons at 10s. per ton (loading charges)=14s. (See dotted line).	£7	5	0
3rd Fouling			
Filling 1.4 tons at 3s. 6d.		5	0
Empty and disintegrate 1.7 tons at 9s. 6d. per ton		16	0
Load for sale 1.7 tons at 10s. per ton		17	0
Routine and mechanical attendance		13	0
	£9	2	0
Value of spent	£9	16	0

Gas purified 3.16 mill. cu. ft. at 450=14.220 therms.

	Credit	*Debit*
Value of spent, pence per therm	.165	
Cost of new oxide		.063
Labour charges, etc.		.090
		.153

Profit per therm made .012d.

Earlier, I stated that an outlet oxygen of 0.4% was suggested, and until 1955 this was adhered to. During the winter of 1955 the purifiers at St. Helens were not working as well as might have been expected. Difficulties faced were.:—

1. Emanation of H_2S from new oxide when working as last box.
2. Inactivity of oxide in the boxes, allowing H_2S to creep towards the general outlet.
   Concentration of H_2S on holder header was frequently 0.2-0.4 p.p.m.

It was during this period that we approached the Board's technical and planning division with our problem, and among possible lines of investigation the main one which we could immediately carry out was the oxygen concentration throughout the series. Previously all tests had been done using an Orsat apparatus. The Board Division suggested that we adopt a method outlined by L. A. Moignard in his paper, 'The Performance of Oxide Purifiers' presented at the 18th Autumn Research Meeting of the Institution of Gas Engineers in 1952.* This method was eventually adopted throughout the Group as a more satisfactory method for oxygen determination, and has helped considerably.

Our first tests showed that the oxygen on outlet purifiers was varying between 0.35% to 0.42%. All air to purifiers is metered, also the resultant purified gas from each stream.

The air to purifiers at this time was 4%, which gave a figure on inlet to purifiers of 0.8% + oxygen in crude gas ex bench which Orsat tests had reported as 0.2% to 0.3%, thus giving an oxygen content on inlet of purifiers of 1.0% to 1.1%. With the new method, we found that the oxygen in the crude gas was as low as 0.03% at times.

It was decided to increase air to purifiers to 5% in order to find out if there would be an improvement in working conditions. This in effect should have increased the oxygen on the outlet by 0.2%. No increase on the general outlet was noticeable for several days. Ultimately, after about four weeks, the oxygen on the holder header had increased from the previous year between 0.35% and 0.42% to the range between 0.49% and 0.54%. We now agreed that our boxes were previously suffering from oxygen starvation.

It is unfortunate that for every 0.2% increase of oxygen on the purifiers 1.3 therms per ton are lost from the bench, but in view of the increased efficiency of working we had no alternative but to allow the air to remain at 5% admission instead of the 4% used previously. This increase of 1% air did help us considerably.

When the oxygen concentration on the outlet of purifiers for trouble-free working and empty box velocity was graphed, it appeared that there was a simple relation between oxygen concentration and empty box velocity,

i.e., oxygen concentration on outlet of purifiers
= empty box velocity × 0.27.

Considering the practical aspect of purification at minimum cost, in order to maintain costs at their lowest, all oxide when emptied from a box is disintegrated, watered, and returned to the same box unless spent. When spent, it is disintegrated and immediately transferred to spent oxide, and new oxide taken from stock to replenish the box. Thus the only handling of oxide is the cost of transferring to spent bay and removal of new oxide from stock. At St. Helens there are four sets of purifiers, two overhead and two ground level sets

* GC7 Appendix 1, p. 507, Trans.I.Gas E., 1952/53.

which require different methods for emptying and filling.

To each box there are four discharging doors. Chutes are led directly into a tundish placed under the purifiers, and fed into the boot of a small elevator to the crusher. Two further chutes are fed directly to the crusher. The outlet of the disintegrator is again fed to the boot of a large elevator, which transfers the watered disintegrated oxide into position for recharging of the box by Goliath crane.

The crusher feeds the crushed watered oxide to the boot of a large elevator which places the oxide in position for recharging the box. Using this method, it is estimated that St. Helens saved approximately £3,000 per annum in costs for preparing charges and redispersal of oxide as against former methods.

In order to keep costs at a minimum every aspect of purification must be considered. The emptying, disintegrating and return of the oxide to the same box eliminates costs of preparing charges and re-disposal of stocks, but the design of the purifiers must be suitable to incorporate this. At St. Helens all the purifiers were admirably suited for the above.

On the overhead installations all valves for operation were alongside the boxes themselves, i.e., in an elevated position, thus leaving at ground level complete freedom for manœuvrability of equipment at minimum costs. The ground level boxes also had the valves positioned adjacent to the boxes, but on one side only. This allowed complete freedom of movement on the side opposite to valve positioning.

A further contribution to the revenue obtainable for spent oxide can be gained by mixing oxides, e.g., works A has 200 tons for sale at 52% sulphur. Works B has 200 tons for sale at 55% sulphur.

Increased revenue obtainable by mixing the above and selling as one consignment.

200 × 52 × 1s. 7½d. =	£855	16	8
200 × 55 × 1s. 8½d. =	939	11	8
	1,795	8	4
400 × 53.5 × 1s. 8½d. =	1,827	18	4

Increase in revenue = £32 10 0 or 1s. 7½d. per ton.

PURIFICATION COSTS AT ST. HELENS 1949-1956
GROUP COSTS 1952-1956*

April 1—March 31		
1949—1950	−£10,800	
1950—1951	− £6,285	
1951—1952	+ £3,644	
1952—1953	+ £5,158	+ £41
1953—1954	− £18	− £6,879
1954—1955	+ £1,864	+ £2,149
1955—1956	+ £1,677	+ £468
1956—1957	+ £215	− £4,291

The high profit in 1951-1952 and 1952-1953 at St. Helens was due to working part spent oxide to spent during that period. Two thousand tons of part spent oxide had accumulated during 1949 and 1950 prior to the installation of No. 3 set and the closing down of smaller Works.

In conclusion, this paper has been presented in an attempt to show that the dry purification of coal gas in conventional iron oxide boxes can be carried out at a profit, providing the necessary equipment is available, that the design of the sets is such that the equipment can be utilised and that the oxides work normally.

The conventional iron oxide process is still a considerable asset in producing suitable purified coal gas for delivery and can be run at very low operating cost. Only capital charges need be of moment, and these still do not exceed 0.2d. per therm.

DISCUSSION

Mr. L. G. Townsend, Chief Chemist, Liverpool Group, opened the discussion. The success of the methods described in the paper depended on two main factors—the practice of returning disintegrated oxide to the box from which it has just been removed . . . and the efforts to work up spent oxide to a relatively high sulphur content at maintained high gas throughput.

The first of these was tried out at Liverpool in 1942. It was very unorthodox. It was prompted by a desire to reduce the amount of oxide lying about on a congested site. And it was immediately successful. Until then it had been assumed that the oxidation of part-spent charges by exposing them to the air, turning them over for an extended period, was an essential part of oxide purification. This had been proved quite unnecessary.

On the question of working the oxide up to high sulphur content, standards of purity must be kept in mind. At Liverpool they considered that purified gas at inlet holder should not contain more than 0.3 H_2S p.p.m. Anything above this called for action. Certainly a figure of 0.5 p.p.m. in delivery gas was too high for comfort.

With regard to purifier capacity, Mr. Townsend could not agree that gas velocity through the empty box was more informative than the R ratio. Neither gave the complete story. For this one must have a number of facts before a true comparison can be made between different sets and different conditions—the R ratio, the depth of oxide, the number of boxes, as well as the H_2S content of the gas, temperature conditions, the sulphur content required in the spent oxide well within their capacities.

He could not agree either that a five-box set would allow only 25% more throughput than a four-box set. He contended that in a four-box set the third taker should always be clean so that only two-and-a-half boxes would be used for the removal of appreciable amounts of H_2S. In a five-box set three-and-a-half boxes would be useful and with a six-box set four-and-a-half. The five-box set would therefore take 40% more gas than a four-box set and it should be possible to put a further 40% through a six-box set. Back pressure would set the limit and five boxes seemed to be the best compromise.

He was amazed that purification could show a profit with current prices for spent oxide. At Liverpool (Athol Street), with similar methods and on the same costing methods the cost was 0.11d. per therm. He thought however that some charges were missing from the author's figures.

He thought that boxes should be run at or near their rated capacity and that rotation every 24 hours should be adhered to—to even-out temperature fluctuation and moisture losses. He could not accept that the throughput of a set can be increased by resorting to divided flow. In his experience, a set will carry its maximum load on downward flow—split streams always increase slip.

There was a quick-firing discussion between Mr. Hollingshead and Mr. Townsend, particularly on the point of the rating of purifiers, which the Chairman was finally obliged, smilingly, to bring to a conclusion.

Mr. N. Wickstead, of Wigan, said the paper might have been entitled 'Conventional dry purification at an unconventional profit.' They had found at Wigan, as at St. Helens, that increased air to purifiers resolved many of their difficulties but any saving they might make on purification could be outweighed by a reduced thermal yield on the retort house. He had re-cast the net cost of gas at Wigan for 1956/57 assuming that the extra air for purification required a reduction of one therm per ton. Allowing for the increased coke for sale the net loss was 0.055d. per therm.

Mr. R. J. S. Thompson, of W. C. Holmes, in a written contribution suggested that the 'R' value, useful at a time when no such simple rule existed, could now be replaced by contact time expressed in seconds. If Mr. Hollingshead's ideal velocities for single layer boxes are converted to total contact time, they come out to 400 seconds in every case, irrespective of the number of boxes. That is satisfactory for gas containing 580 grains of H_2S per 100 cu.ft. of gas. It was good practice to allow 500 seconds for gas containing 500 grains per 100 cu.ft. The performance of Mr. Hollingshead's plant was peculiar in that only his first fouling is at 400 seconds. His second is at somewhere near 500 and his third at about 570 seconds. His particular discovery is that for the first and second foulings, when the oxide is in better condition, he can reduce the contact time to something much lower than that normally allowed.

Mr. J. G. Tilley, Senior Vice-Chairman, moving a vote of thanks, contended that what was important was that the process was run at a profit. When the capital charges were added the process was still 'in the red,' but Mr. Hollingshead has shown that for some years at St. Helens, it had really worked.

Mr. A. H. Nicholson, Junior Vice-Chairman, seconding, said they had been regaled with one of the best discussions they had ever had at their autumn meeting.

*The Group is St. Helens, Warrington, Wigan and Widnes.

From a paper to the 23rd Autumn Research Meeting, November 19-20.

Recent Work on the Flaking of Refractories

By J. H. WYLDE, F.R.I.C., Assoc.M.Inst.Gas E.,
LONDON RESEARCH STATION, THE GAS COUNCIL.

WHEN, in the early part of the year, I was asked to prepare a paper on flaking, I agreed, but with some misgiving, for at the time it seemed that our contribution was likely to be of a negative character. The retort house in which all the special refractories were placed, was still at work. We knew that the firebrick had failed in a similar manner to the sillimanite, and the distortion in shape of this brickwork prevented us from obtaining a clear view of the impermeable test bricks.

We were breaking new ground in our plan to recover intact a large number of retort sections and, at best, these results would not come to hand until very close to the time when the paper was required for printing. That the project was successfully accomplished is due to the efforts of a team of young enthusiasts in co-operation with the contractors and the works engineering staff. On this account I am pleased that the work has been fruitful in advancing our knowledge, and not so negative in character as I had feared.

In the introduction, attention is drawn to the long life and freedom from flaking that is given by firebrick retorts when operated at combustion chamber temperatures around 1,200°C., but we found that firebrick was failing very early in its life. Unfortunately no similar information is available for lime bonded silica bricks. It would certainly be valuable to know the effect of temperature reduction both on coal throughput and also on flaking damage. My power of persuasion in this respect, however, fell on very stony ground.

Turning to the brick trials under service conditions, our dissatisfaction with the method of assessing flaking damage in Trial 1 led to the much improved method that was used for Trial 4 when low porosity silica bricks made from imported rock were compared with a British product. This Trial has shown that a small reduction in the damage is obtained by using silica bricks with a reduced porosity and permeability and higher mechanical strength. In profile the damaged retort faces with both materials show clearly the effect of the proximity of the zone of highest temperature to a gas rich in hydrocarbons. Flaking is severe when these conditions prevail. A thick and therefore strong layer of scurf is produced, but it is doubtful if this is directly responsible for the flaking damage. The damage is caused when the scurf is being removed during the scurfing operation. The evidence for this statement is to be found in the behaviour of the two alumino-silicate refractories in Trials 2 and 3.

In these two Trials, the sillimanite, and 50% alumina firebricks, behaved similarly in that little loss from the brick surface was found, but both refractories split and curled in shape as shown in Figs. 1, 2 and 3 of the paper. The only explanation for this behaviour that seems reasonable is that the scurf is so effectively bonded to the brickwork that when it buckles and curls away from the retort face during combustion, the bricks are forced to conform to this movement, with the splitting and distortion in shape that was found.

Immunity of Narrow End Walls

An explanation for the cause of flaking must take into account the comparative immunity of the narrow end walls in the retorts. It is suggested that the disparity in size between the walls, and consequently the size of the sheets of scurf is sufficient to explain this difference in behaviour.

Pyro-plastic deformation is to be expected with alumino-silicate refractories under stress at high temperature. The same stress applied to a lime bonded silica brick would be expected to produce the characteristic brittle fracture known as flaking.

The confidence with which such statements can be made results from the fundamental research work on the physical properties of refractories that has been sponsored by the industry. It is a typical example of the value of such work when applied to an industrial problem. That this stress can be resisted is shown by the behaviour in Trials 5 and 6 of two different refractories both having the properties of high strength and with zero or very low porosity and permeability. These special bricks have served their purpose in establishing this resistance, but they are too expensive to contemplate for general use.

The brick trials have enabled us, first to advance an explanation for the cause of flaking, secondly to prove that bricks with suitable physical properties will resist both flaking and distortion and lastly that a small, but significant improvement results from using lime bonded silica bricks, since these same properties are improved but only to a limited extent.

If the explanation for the cause of flaking is correct, then the importance of the investigation concerned with producing a 'Code of Scurfing Procedure' is apparent, and should be given every encouragement. If the scurf layer can be removed without causing it to buckle or curl then flaking may be appreciably reduced. I would suggest that the objective in this investigation should be the removal of the scurf within the range of temperature at which it is formed.

Our work in the laboratory which is concerned with the production of bricks with high strength and low permeability has shown that the normal kilning temperatures of 1,450°C. are too low for bricks that may occasionally be subjected to similar temperatures in use. Improved physical properties can be obtained with both a silica and china clay refractory if the kilning temperature is increased. Examples of such products are given in Table 12. The contraction in volume that accompanies this improvement would however probably result in bricks that are variable both in shape and dimensions.

The Joint Refractories Committee is so constituted that we shall be able to seek advice from brick makers at this stage of the work.

Lastly we come to the glazing of lime bonded silica bricks. The technique that has been developed for glazing this most difficult body will be applied to one retort this year. At best, it is a very slender barrier to the destructive forces responsible for flaking and it is not proposed to offer any further comment on this treatment until we have experience of its behaviour in use.

DISCUSSION

Mr. H. M. Spiers (Woodall Duckham Construction Co., Ltd.), 'The painstaking investigation which Mr. Wylde carried out after they had been dismantled, on retorts in the flaking zone of which a variety of different types of bricks had been incorporated has provided some very useful information. Silica bricks, such as silcrete bricks, with a low permeability have once more been shown to suffer a smaller flaking loss than do bricks with a higher permeability. In this connection it may be mentioned that one English brickmaker has succeeded in producing bricks of low permeability from a British quartzite. A practical trial of this material may be well worth while.

'Sillimanite bricks once again gave disappointing results, as also did bricks with an alumina content of 50%. The fusion-cast bricks and the brick cut from natural Assam sillimanite were, of course, included in the programme of tests in order that the belief that non-permeable bricks would not flake might be checked. In fact, they did not flake and it would appear that there is now incontrovertible evidence that bricks which have a neglible permeability are unaffected by scurf and by the scurfing operation. The materials which were tried would, however, be far too expensive for use on a large scale. It is not surprising therefore that Mr. Wylde should have turned his attention to the development of means whereby conventional

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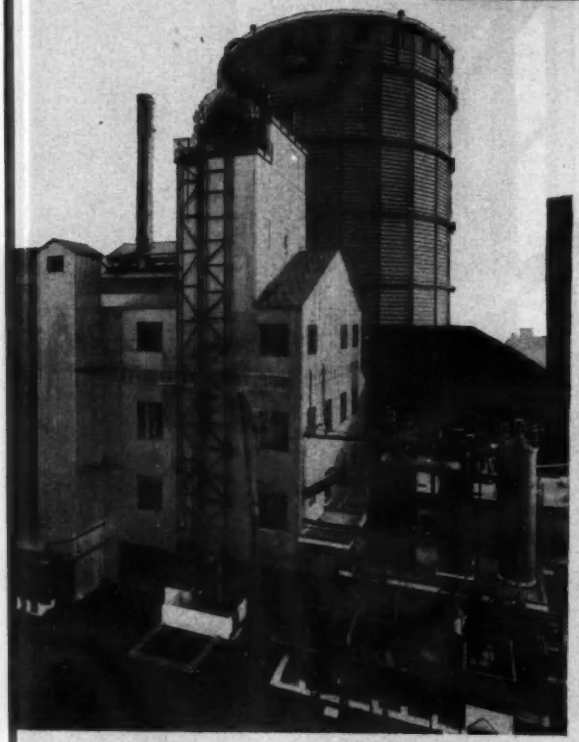

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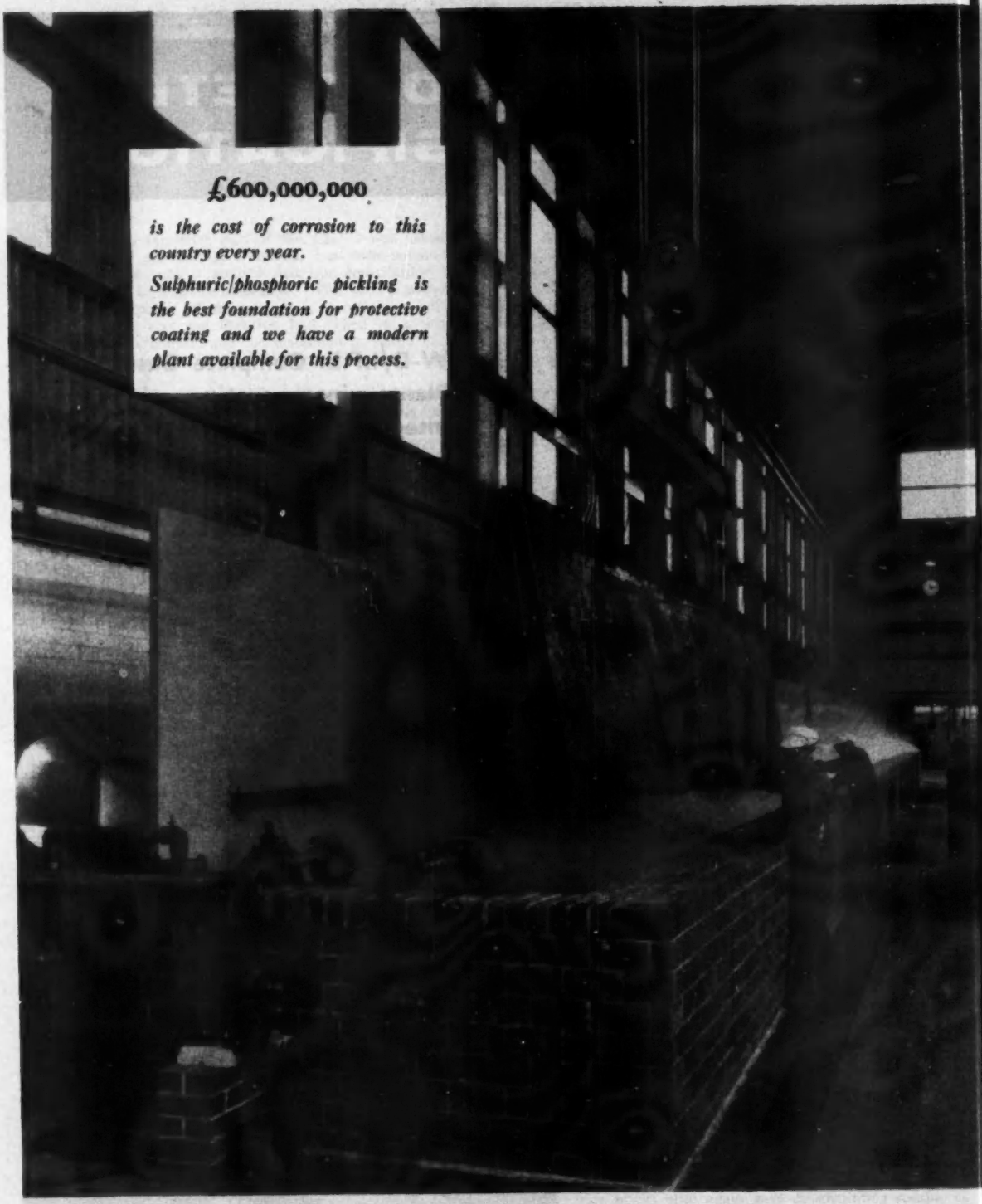
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silica bricks might be rendered almost impermeable or be given a coating to reduce their surface permeability.

'He has had a measure of success with surface glazes for silica bricks, such glazes being preferably developed on the retort side face of the bricks after the setting has been heated up. As he recognises, difficulties may arise through the fusibility and consequent abradability of a glaze applied in this way, although he thinks that it may be possible, by means of spray-welding, to make use of a more refractory glaze. With a refractory glaze it would be necessary to ensure that the reversible thermal expansion of the glaze is compatible with that of the brick. Glazing of bricks *in situ* is not altogether new. In the twenties' Poulson's cement was in use for the glazing of retorts. Fire-bricks coated during manufacture with a glaze on one face have, moreover, been used in gas flues to reduce frictional losses.

'Mr. Wylde has found that, with clay-bonded silica bricks, a high bulk density and a very low permeability throughout the brick can be achieved if the bricks are fired to a sufficiently high temperature, namely 1,600°C., although he rightly points out that the large shrinkage which will occur in the kiln will present difficulties if the customary dimensional tolerances are to be maintained. Bricks of low permeability are also obtainable from highly-grogged china clay if the moulding pressure and the firing temperature are sufficiently high, but it may be doubted whether the under-load behaviour of such bricks would be good enough.

Mr. M. S. Gaskill (Wests Gas Improvement Co., Ltd.): 'Mr. Wylde's valuable research into this important subject is particularly outstanding since the study of the flaking of refractory materials under operating conditions is extremely difficult. In the first place the quantitative assessment of flaking loss presents a great problem. I would suggest that the recovery and measurement of retort bricks after the installation has been cooled down may not give a true indication, since very considerable disintegration may take place under certain conditions during cooling. A practical illustration of this may be quoted in a recent instance when an installation was shut down in order to maintain the repair cycle. Previously to shutting down the retort inspection under heat showed them to be in reasonably good condition. On cooling, however, there was heavy scurf which would have rendered further satisfactory operation doubtful. Other retorts of the installation which had been gas making under similar conditions for the same period continued to operate satisfactorily.

'The relationship between porosity and flaking is undoubted, and if bricks of no porosity could be obtained, many of our problems would be solved. However, it is doubtful whether such bricks are an economic proposition. In the low temperature range the porosity of the material does not appear to be very important. The safe temperature is dependent to a considerable extent on coal characteristics. The problem is therefore extremely difficult, and it is doubtful whether a solution lies wholly in the reduction of porosity or in the proposal for longer retorts operating at lower temperatures.

'The section on the glazing of retorts was very interesting. From what we have heard in the Refractories Report such a procedure does not appear to be very promising; but anyone who has had practical experience in this connection must have observed cases in which retorts have been glazed, and in such cases the incidence of scurf and damage to the retort have been very considerably reduced. I would therefore suggest that this work is still worth pursuing, although I have some doubt, based on experience of spray welding, of the application of that method to the glazing of retort surfaces.

'There is another point which arises in connection with porosity and the question of glazing. In the Refractories Report it was mentioned that not only had porosity increased with glazing, but in certain cases untreated samples of the brick showed greater porosity on reheating. It may be that similar cases happen in practice due to the rapid reheating of the brick during the scurfing operation. Mention has also been made of scurfing operations, of the deplorable way in which they were carried out, and how in recent years there has been considerable improvement; but I would suggest that there is still room for very careful study and the very careful application of this process.'

Dr. A. E. Haffner (Chief Engineer, Southern Gas Board): 'Mr. Wylde's paper is important because flaking continues to limit the life of refractories and to cause premature shut downs of baseload continuous vertical retort plant of high capital value. If, by eliminating flaking, shut-down for repairs and reconstruction were changed from 15%—that is, a six months' shut down in three years, in the worst cases—to 5%—that is, a six months' shut-down in ten years—the rising costs of plant would at least have been compensated for two years. This does not take into account the deterioration in coal travel and increased leakage as flaking progresses. Its importance is less under Scottish conditions and, free from this problem, our Scottish colleagues—or those of them still working in Scotland—may wonder what all the fuss is about.

'When scurf attaches itself to the retort face it does so by forming a bond within microscopic permeable cavities. When it detaches itself by thermal bowing the pieces of scurf which are recovered have a curvature convex towards the flat surface they have left. Often the detached pieces have flakes of refractory in them. To flatten the scurf requires a force which is consistent with overcoming the tensile strength of the refractory and pushing out flakes if the adhesion of the scurf is strong enough. This is the simple picture which Mr. Wylde presents and it is consistent with the facts that flaking is most severe wherever scurf deposits are greatest, the refraction most penetrable and the refractory least strong.

'The failure of sillimanite and 50% alumina firebrick chosen for its similarity to carbon in coefficient of expansion is related to viscous deformation under stress at high temperature, and the peculiar shape like a stale sandwich is attributed to the bowing of the detached scurf. While attracted to this I would like a doubt to be removed because the ends of the detaching scurf could equally well be located in the middle of the bricks and not at the ends and, if so, would not cause this peculiar appearance.

'The measurement of flaking losses in the comparison between British and South African silica was very carefully carried out, and I should like to know whether minor axis measurements were also taken in the methods used by others to see to what extent the measurements reported here can be correlated with earlier work. Mr. Wylde has taken a large sample, but he agrees that a smaller sample would suffice. There is still the need for relatively simple retort measurements to be carried out before demolition, with minimum interference with demolition programme, so that losses due to flaking can be established for a maximum number of cases in different parts of the country.

Mr. J. H. Wylde (in reply): 'Mr. Spiers referred to the reversible thermal expansion of the glaze being compatible with that of the brick. He realises that the temperature range involved for the thermal expansion of silica bricks is of a low order. We do not visualise the retention of the glaze after it has passed through the high-low temperature reversal.

'I would draw attention to the fact that we have found under-load characteristics of 50% alumina firebricks under the conditions discussed to be satisfactory. With regard to bulk density and the comparative absence of iron compounds, it is more than likely that china clay refractories with these properties would meet loading conditions.

'Mr. Gaskill referred to the fact that in the assessment of flaking loss disintegration occurs as a result of cooling. We are aware that the bricks are found in a cracked condition and uncracked when examined before they are demolished. Cracking did not trouble us because we joined the pieces together. We have not found that pieces are detached from the surface and contribute to flaking losses. We have found remarkably little additional loss from the surface of the bricks as a result of cooling loss. Referring to the longer retort, I take it that he had in mind the desirability of a better temperature distribution along the length of the retort. If it is possible to confine the high temperatures where there is the least gas then most of the troubles disappear. The masking effect of small panels is relevant. In this instance the panels are themselves exposed to greater stress and compression, yet despite this they escaped damage.

'Dr. Haffner mentioned minor axis measurement. No measurements were taken. He could not see why the ends of the brick were vulnerable and why the centres should not be curled. I think that is based upon the fact that the joining cement is extremely permeable. It is one of the first pieces of refractory to be removed on scurfing, and the scurf can gain greater purchase on the ends of the brick because there are two faces exposed to carbon penetration.

From a paper to the 23rd Autumn Research Meeting, London, November 19-20.

A Comparison of Heating Systems in Two Occupied Houses

By D. R. WILLS, B.Sc.(Hons. Eng.),A.C.G.I., M.Inst.Gas E., M.I.H.V.E., A.M.I.Mech.E.

and

P. R. CHANCE, Assoc.M.Inst.Gas E.,

LONDON RESEARCH STATION, WATSON HOUSE.

LONG period tests, covering summer and winter seasons, were carried out on two houses of conventional design (local authority built) of 956 sq. ft. floor area, insulated to a high standard. In the tests, emphasis was on comparisons of all-gas and gas-coke heat services.

Basic data are presented on the heating of occupied houses to different temperature and comfort levels, using various combinations of appliances and heating systems. The use of warm air heated by gas has received particular attention. Comparisons have been made between warm-air ceiling panels; warm-air convection heating and flueless background heating, with gas fires for supplementary heating in each case. Different levels of background heating have been employed, ranging from a relatively low value to higher levels generally associated with whole-house heating. Finally, the all-gas systems were replaced by coke open fires with large back boilers to enable a comparison between the all-gas and the more conventional solid-fuel systems to be made.

The levels of heating used were chosen mainly by the occupants, and economic factors were largely eliminated as special arrangements of payment for the fuel used were a necessary part of the programme. These arrangements permitted the higher standards of heating to be compared. It was necessary to adapt conventional-type houses to accommodate the experimental warm-air systems, and they were also insulated to a level similar to the higher Egerton standard. Records of temperatures, fuel consumptions and other observations were taken over six heating seasons and are presented mainly in the form of regression analyses.

The occupants were taken in rotation from the housing authority waiting list, house 19 having five in family, including three children, and house 21 six, including four children. During the 'all-gas' periods, it was intended to use different forms and levels of background heating supplemented by gas fires. The houses were equipped as follows:—

House 19

(*a*) *Warm Air Heating.*—A gas-fired air heater of 25,000 B.Th.U. per hour normal output was installed in a recess in the kitchen with flow and return ducts between the ground-floor ceiling joists. Warm air was delivered at high level to the kitchen and living-room, and at low level to the hall, bathroom and three bedrooms. The return air grille was at high level in the hall. Low-level delivery is preferable, but such provision entailed more modification to the houses than was justified, as eventual restoration to a normal solid-fuel system was to be made.

(*b*) *Flueless Heaters.*—Flueless heaters in the living-room, kitchen and hall provided an alternative system of partial background heating having a total input of about 10,000 B.Th.U. per hour.

Additional Heating by Gas Fires

A convector gas fire was installed in the living-room, and panel fires in the bedrooms as flexible supplements to the 'base' system.

Heating by Coke

At the conclusion of the all-gas test periods, the air heater, background heaters and gas fire in the living-room were replaced by an improved open-type coke fire with finned back boiler. This supplies space heating for the living-room, the main hot water and 20 sq. ft. of radiator surface in the kitchen. The bedroom panel fires were retained.

House 21

(*a*) *Warm Air Panel Heating.*—A similar air heater to that installed in house 19 supplied warm air to a ceiling panel system. Panels in the form of shallow ducts were fixed to the underside of the ground-floor ceiling joists in the living-room, kitchen and hall. Each panel comprised parallel ducts fed by a cross header at one end and a second header at the other end to collect the air for return to the heater. The systems were designed to give a ceiling temperature of 75°F. to 80°F.

(*b*) *Warm Air Heating.*—By providing duct isolating dampers, the ceiling panels could be isolated and warm air supplied direct to each room as in house 19.

(*c*) *Flueless Heaters.*—Flueless heaters were provided as an alternative background heating system, with gas fires as in house 19.

The coke heating system was identical with that of house 19.

Gas cookers and wash boilers were provided for each house, and the hot water was supplied in house 19 by a storage system with gas circulator and a boiling-water sink heater. In house 21, an instantaneous multi-point heater supplied all hot water demands. When the coke systems were installed, 'Primatic' indirect storage cylinders were fitted, and the gas water heaters were retained for summer use at the tenants' discretion.

Although precise assessments are difficult, in view of the many uncontrollable variants present in field experiments described in this paper, broad conclusions appear permissible:—

(1) The heating standards provided were all higher than conventional for the class of house in question.

(2) With the combination of warm-air background heating and gas fires, extreme flexibility was available and a wide range of levels of heating could be achieved as desired. There seems no reason why very good standards with relatively low fuel consumptions should not be obtained, particularly with supplementary heating, in a main room only, by a high-efficiency convector gas fire.

(3) The occupants expressed greater satisfaction with the lower levels of background heating supplemented as required by gas fires rather than with a high level of background heating by warm air. Both families stated they felt the need for greater 'freshness' and desired to open windows when high levels of warm-air heating were used. Both families felt the focal source of radiant heat in the living-room to be essential.

(4) There was some evidence that with the higher background temperatures by warm air the 'effectiveness' became less: In other words, the 'therms per degree difference in inside/outside temperature' seemed greater at the higher temperature difference levels. This could be due to the difference in relationship between the temperature distribution pattern and the fixed temperature sampling-points, but also to the general inexperience of the families in regard to warm-air heating.

The first factor is a variant present in experimental work

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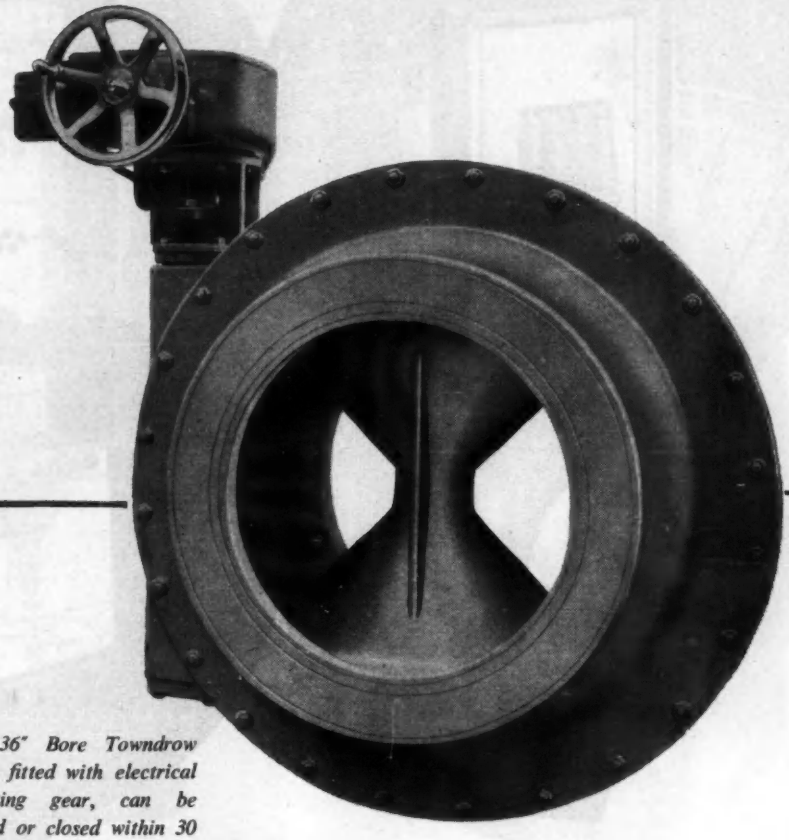

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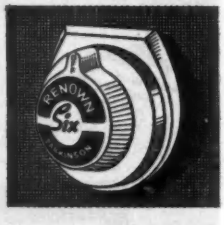

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of this kind and could be partially responsible for some of the differences between the systems.

The second factor is an important one, and it would appear desirable, when warm-air heating is applied, to give particular attention to the manner of distribution of the warm air and the ventilation rates; for example, it would appear seldom necessary to supply warm air direct to the bedrooms. In this country, people are generally unaccustomed to warm air heating methods, and some 'conditioning' in warm air usage is, perhaps, necessary. In any case, intelligent use of the systems is required if economy is to be achieved.

(5) It is essential that, if the achievement of higher heating standards is to be considered, the question of thermal insulation must be given due attention. One advantage, apart from reduction in general heat requirements, is that bedrooms would be warm enough without additional heating.

(6) The 'system efficiencies' of all the gas systems approached 80% in the present tests, and these results are generally consistent with other work in this field.

(7) Comparisons with particular coke systems in the present case suggest the difference in weekly costs for similar standards to be small, with greater opportunities for economy with the gas by reason of greater flexibility.

(8) With all-gas systems, the 'peak' week consumption can be from 2.0 to 2.5 times the average, and the question of suitable tariffs and method of payment could well decide their general acceptability to the user.

(9) The ceiling panel system gave a high standard of general comfort comparatively economically; it was, in fact, the preferred system (by the occupants) in this house. Such systems are somewhat sluggish in response to thermostatic control, and, if used at all as background systems, would seem to lend themselves less well to flexible operation at lower standards than direct heating by warm air. The capital costs would be much higher than the simpler warm-air system.

(10) As a general comment resulting from their experience in this experimental field, the Authors doubt whether this kind of experimental approach to the problem under consideration can yield more than a limited amount of data in a form applicable to the general case. Long periods, innumerable observations, many analyses (often tedious), are involved because the variants are great in number and complexity. It would seem that while this type of approach has a real value it would now be better to concentrate on experimental work where conditions approaching laboratory control of the variants are possible, with supplementary field work of a statistical nature with a sufficient number of samples of the selected systems.

DISCUSSION

Mr. J. B. Dick (Principal Scientific Officer, Building Research Station): 'I agree with the authors that we cannot generalise from only two occupants; to get any real idea of general trends one needs a much larger sample. I think, therefore, that we should concentrate on the technical performance of the systems and the houses in which they are installed, and so examine concepts such as appliance efficiency, room heating efficiency—that is, the heat into a room from an appliance—house efficiency, the heat into the house, including the gain off the flue, and, eventually, the system efficiency.

'As we at the Building Research Station introduced this last term, perhaps I could point out some of its limitations. I think one has to be careful with its use, for if you examine it closely you will see that it is not a characteristic of the system itself. It is, in fact, a characteristic of the system in the house, and if you change the insulation standard of the house, you will change the proportion of heat which is employed directly from space heating in relation to the heat that comes from the miscellaneous gains, such as lighting and cooking. Therefore, one would change the system efficiency as one changes the insulation of houses. The same applies if one changes the standard of heating.

'I think it is better to approach the estimate of consumptions from the heat balance for the house using appliance efficiencies and house efficiencies. (This is in fact what Mr. Wills has done behind the scenes, but he has not reported very fully exactly how he has treated it.) The balance and the subsequent estimates can then be made for any given standard of heating, and one can clearly see the effects of changes of input to given appliances and can extrapolate to dwellings with other grades of insulation.

'There is an important point about these estimates as they are made nowadays with the increased information in our possession. They are on a much firmer basis than they were ten years ago. You will remember that the Egerton Committee in its examination of domestic heating at the end of the war found a complete lack of data on temperatures in dwellings, and in its estimates of consumptions it had to make certain simplifying assumptions. For example, it assumed that the temperature in the room during the day should be 65° and that the temperature at night should be 50°. It then calculated what the heat loss from the room was for these conditions and added an amount for intermittent heating. However, we know from these studies and from other studies that such things do not happen in dwellings. If one has a temperature of 65° during the day and a reasonable standard of insulation, even in cold weather it will probably not drop below 55°. So the estimates that can be made nowadays are much nearer the mark than the estimates that the Egerton Committee had to make. This is no reflection on the Egerton Committee. It would be a reflection on the research workers if ten years after the Committee had set up the problem for them they were not able to give some of the answers. Mr. Wills' data will, I think, enable much firmer estimates to be made of a range of systems in houses and also in flats.

System Deficiencies

'There are one or two points on system efficiency. I am rather puzzled about Table 6 (in the original paper). Can the authors provide some information on the figures used in the estimation of system efficiencies for the coke fires, as given in that Table? Can the authors explain how column 6 is arrived at ? Does it come from assumed appliance efficiencies? What has happened to the water heating?

'I was particularly interested to read the authors' comments on bedroom temperatures. In these well insulated houses they found that the bedrooms were probably warm enough without additional heating, or at least without background heating. This was also our experience in our houses at Abbots Langley. I do not think that it is necessarily true of all dwellings, for many of the houses going up today could provide much more comfortable conditions if they were better insulated. The standard is improving, but there is still plenty of room for improvement. I agree with Mr. Wills that it is particularly worth while to have a good standard of insulation where heating is by warm air.

'I would like the author's observations on types of systems where space heating is restricted to the living room and kitchen (this may be acceptable for quite a proportion of houses) and on the relationship between background and intermittent heating.'

Mr. A. R. Bennett (Director of Research, Radiation Group Sales, Ltd.): 'It is now very generally recognised that the gas industry's approach to space heating in the post-war period has been unduly timid, and despite the efforts of the last year or so to retrieve the position, the public generally have a very poor appreciation of the real merits of the services the industry is now in a position to offer. Unfortunately, also, the industry itself is not entirely free from misconceptions and disagreements as to the strength of its case, and there is, therefore, an urgent need for careful and factual investigation of the type reported in the present paper. This work enables comparisons to be drawn between some of the known means of transmitting heat from a heat source to the rooms where heating is desired.

'It is noteworthy that certain of the limitations of the field work of the Building Research Station at Abbots Langley apply also to the work reported in this paper. I refer particularly to the factors of warm air temperature distribution and of radiant flux as affecting the relationship between room temperatures selected for record purposes and the comfort of the occupants. In the absence of quantitative estimates of the effects from a comfort standpoint of the use of a proportion of radiant energy or an alteration in the vertical temperature gradient it is difficult to give a realistic figure of merit to heating systems of markedly different characteristics.

'It is known that the high level discharge of warm air used in the installations described is less effective than a low level

discharge in that vertical temperature gradients are accentuated and hence the mean temperature of the room and consequently the heat losses are higher for a given standard of comfort at the occupied levels. Experience shows that a fuel saving of 20-40% can be achieved by careful attention to this factor. The Egerton Committee concluded that for good comfort conditions the temperature difference between floor and head levels should not exceed 5°F. Very little is said in the paper about vertical temperature gradients and I feel sure that several of the authors' conclusions in regard to the merits of the warm air system could have been made much more strongly if a better distribution system had been used; for example, the urge of the tenants to open windows and thus dissipate heat is accentuated by higher temperatures at breathing level than are necessary to ensure body comfort. Both the radiant heat source and the low level discharge have undoubted advantages in this connection, the effect of the former being well illustrated in fig. 24 of the paper. The authors are obviously well aware of these limitations but it should be emphasised that their very careful measurements and analysis do not in fact bring out the best conditions that can be achieved by the appliances used. They confirm the experimental findings at Stanmore in our own investigation of the ceiling panel system and we have never advocated this type of installation. Its rate of response to changing conditions, although more rapid than that of an electric off-peak storage system, does not compare with that of the direct warm air and combined radiant-convection systems.

Lower Running Costs

'The comparison between the coke-gas combination and all-gas systems is of particular interest in view of the assumptions often made regarding the lower running costs of solid fuel open fire installations. It would appear, however, that the assumption made by the authors in their estimates of house heating efficiency that all heat released in the house is useful still leaves their conclusions biased towards the less flexible systems. If full use be made of the flexibility of gas appliances the economic advantage of solid fuels in many households is very marginal. As the authors point out, this applies particularly to the growing number of households in which the heating demand is highly intermittent. In such households there is little doubt that gas heating is not only much more convenient but also cheaper than heating by orthodox solid fuel appliances.

'It is unfortunate that there seems to be no simple way of presenting the facts about heating comparisons in a conclusive and easily assimilated form. The conclusions given on p. 50 and 51 (of the original) hardly do justice to the amount of useful information contained in the paper, and in conclusion No. 10 the authors themselves recognise this position and make a suggestion as to how future work in this field should be conducted. This is undoubtedly a realistic approach and it is to be hoped that those responsible for planning future programmes of work on this subject will take due note of the authors' recommendations.'

Mr. G. H. Fuidge (Chief Physicist, South Eastern Gas Board): 'Few of us perhaps realise the enormous amount of work that must have been involved in collating and analysing the mass of data from the two specially equipped houses over six heating seasons. We must be grateful to the authors for undertaking this task, and presenting their findings in regression curves from which the effects of the different variants can be deduced. As we would expect from Mr. Wills and his colleagues the data is supplemented by the most carefully considered conclusions and these are most useful to all of us concerned with the problems of space heating by gas. In particular, they have drawn attention to the large difference between the average weekly fuel consumptions for space heating and the maximum, which shows the danger of installing space heating equipment on prepayment meter supplies, and also to the need for a heating system to have an adequate margin to cover the preheating period of intermittent heating.

'The authors would agree that the systems installed in the two houses are somewhat unusual. In the case of panel heating the modern tendency is for these to be in the floors rather than in the ceilings and in the case of air heating for the discharge to be at low level rather than high level. These differences perhaps limit somewhat the extent to which the results given in the paper can be applied to modern systems.

'In other work on heating by warmed air considerable differences have been found in the vertical temperature gradient according to whether the air discharge is at low or high level. Do the authors think that the need of the tenants for radiant heating was at all connected with a high temperature gradient with the air heating so that the temperatures at the lower levels of the living room were unduly low?

'It is interesting to note that certain of the findings of the authors suggest that partial heating of a house in a selective manner can give a standard of comfort which may be as acceptable as whole house heating, but with a markedly lower fuel consumption. One example is the considerable reduction in gas consumption that resulted from moving the thermostat from the hall to the living room. Another is the fact that adequate heat was obtained in the first floor bedrooms by gravity circulation of air from the heating system without using the special ducts.

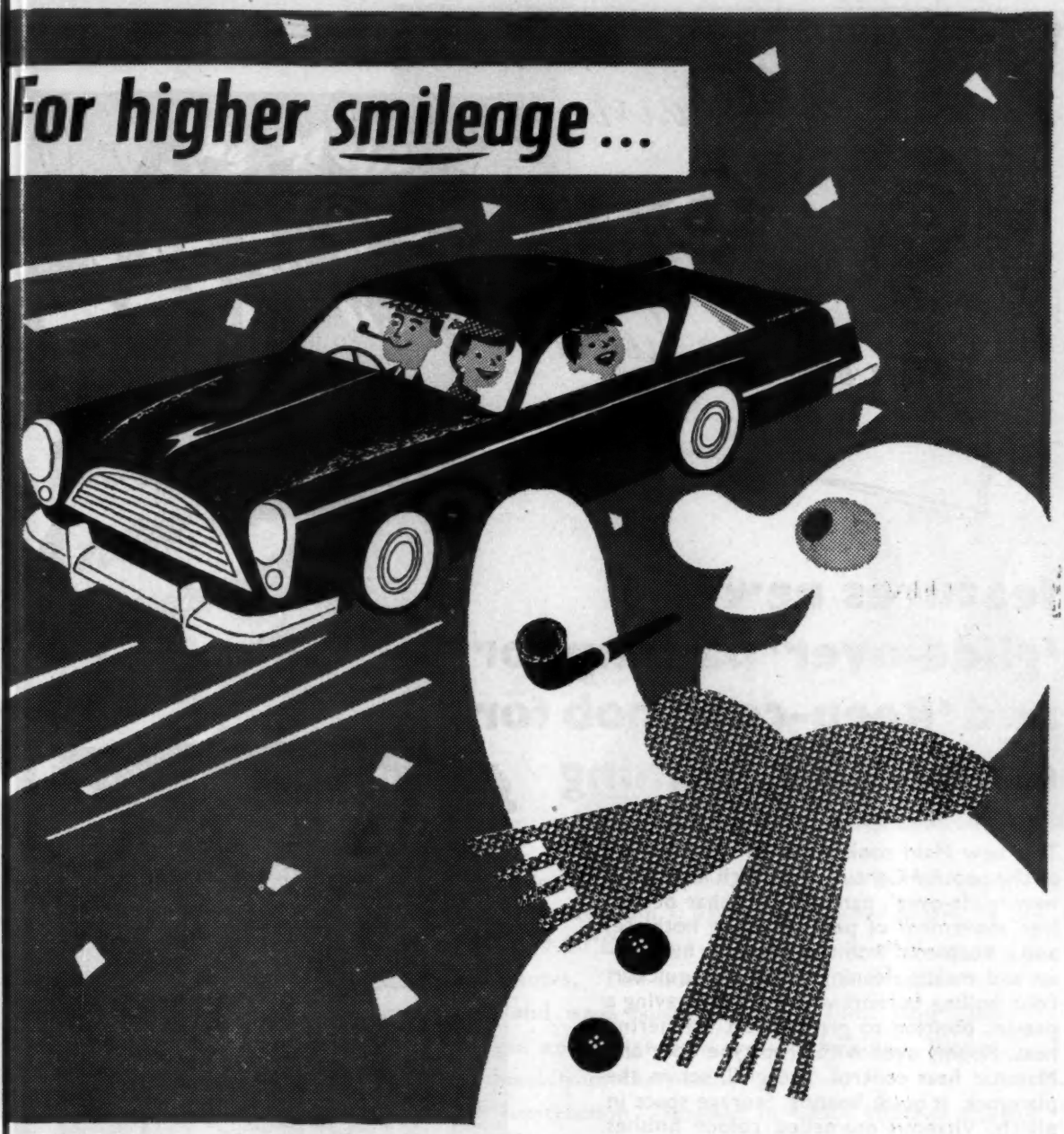
'This reinforces what Mr. Dick said about the limitation of the concept of "mean house temperature" as a method of measuring the system efficiency of a heating installation. By this method it is easy to give undue weight to the more or less accidental heating of the upper part of the house from appliances on the ground floor. By consideration of the results for system efficiency calculated in this way it might be concluded that the bench efficiencies of appliances had no value at all, since system efficiencies approaching 80% can be obtained with gas fires which have a bench efficiency of only 55%; this would suggest that there was little value in increasing bench efficiencies. Would the authors agree that a heating installation is normally controlled to give satisfactory comfort in the living room and that it is the room efficiency rather than the house efficiency that determines fuel consumptions? One would expect room efficiency to be more closely related to bench efficiency than is the "mean house temperature."

'In their last conclusion the authors express some doubt as to whether this kind of experimental approach to the problem can yield all the data that is required. They have drawn attention to the difficulties, and, although they have extracted much useful information from these trials, this has needed the collection of data over many years and much work in analysing the results. This method would obviously be unsuitable if a decision was required as to whether some new system of heating was satisfactory and could be exploited commercially.

Tests in New House

'I have been concerned with tests on a new house provided with an air heating system. This method, of course, is not new and is similar to that used by the Building Research Station in the "unoccupied phase" of the Abbots Langley experiments and that used by Davison, Kimber and Tullet of the B.C.U.R.A. in house heating field tests. In our case it was necessary to obtain in a relatively short time information on the standards of comfort that could be obtained and on probable running costs. By equipping the house with a comprehensive installation of thermometers and recording thermocouples and by adopting a schedule of usage of the appliances to stimulate conditions of occupancy it was possible to obtain the necessary basic information in the course of a month or so. Had the house been occupied this would have been impossible. Since the conditions during the tests were known precisely it was possible to give reasonable estimates of costs for different methods of usage under a range of weather conditions. I should be interested to have the authors' views on this method of approach to the problem.'

Mr. D. V. Brook (British Coal Utilisation Research Association): 'Since we at B.C.U.R.A. have also carried out extensive field trials on the heating of private houses, I have been drawing some comparisons between the gas-fired systems described and our own coke-fired central heating installations. The points I want to make are, therefore, not so much concerned with the pros and cons of the various gas heating systems investigated by Mr. Wills and Mr. Chance, as with the comparisons they have made between these systems and the coke-burning open fire with back boiler. These comparisons may be somewhat misleading. The gas heating systems were capable of a much more comprehensive standard of heating than was the open fire and back boiler with one small radiator in the kitchen. If one offsets the open-fire in the living room against the warm air from the ducts in that room, plus the gas



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convector heater, in the case of the first house, one is then comparing ducted warm air to all the other rooms of the house, on the one hand, with the heat from one small radiator fitted in the kitchen, which is really only an adjunct to the domestic hot water supply system, on the other. An almost equally one-sided comparison has been made in the case of the other gas heating schemes described.

'It seems to me that a more realistic comparison would have been possible had the gas-fired system been replaced by an independent coke boiler in the kitchen, supplying radiators in the living room, hall and bedrooms having a combined output of 25,000 B.Th.U. per hour—the same as the warm air systems—together with a radiant heater, either gas or solid fuel, in the living room. In this case, the independent boiler would have a thermal efficiency of about 70%, which is very much higher than that of the open fire and back boiler, and, using an up-to-date radiator system, such as the new small-pipe central heating system, would give a system efficiency equal to that of the gas-fired installation. The therms input would then be no more than with the gas-fired system, and the running costs only about one-third of those with gas.

Qualification Needed

'I also feel that the numerous references to the inflexibility of the solid fuel system need some qualification. They are certainly true of the open fire and back boiler, but not of a modern coke-fired central heating system having an output comparable with that of the gas-fired installations. Hot water heating systems with pumped circulation and newly developed automatic controls are sufficiently flexible for intermittent heating for all but the shortest periods.

'Finally, I should like to ask Mr. Wills if he can give the costs of installing the gas heating equipment in these two houses. The installation of ducts for warm air heating systems is generally considered to be a practical proposition only for new houses. Even so, it would be interesting to see how the total cost of the ducting or the panel system, together with the convector heater in the lounge and panel heaters in the bedrooms, plus the hot water storage heater or instantaneous multi-point heater, compared with that of a modern coke-fired combined central heating and hot water supply system of similar rating.'

Mr. G. E. Currier (Deputy Chairman, North Eastern Gas Board, and Hon. Secretary of the Institution): 'The problem of house heating is very complex, and, while basic principles may be similar, actual levels of heat requirements, and, therefore, cost, are affected by geographical location and many other more personal factors. The information reported in this paper in regard to appliance rating and the design of air heaters is invaluable, but I am always doubtful of the day-to-day interpretations that may be placed on investigations of this nature and the authors themselves are doubtful if this kind of experimental approach can yield more than a limited amount of data applicable to the general position, and suggest a more strictly laboratory approach. I agree that there are certain limitations in the present approach but suggest that future work should include a greater use of field survey.

'In the work described the number of test houses or samples is small and comparisons of any two systems or types cannot be carried out in identical or typical conditions, the results must be affected by the somewhat "artificial" conditions in regard to running costs and test atmosphere.

'I imagine it would be possible to obtain sound comparisons of the relative performances of different fuels and systems by asking for the co-operation of the many thousands of gas board staff in compiling records, for later statistical analysis, of their own gas and/or coke consumption. Classification of properties into detached, semi-detached and terrace house sizes will of course be necessary with sub-division in regard to size, geographical or degree day location and aspect, with further sub-division in regard to family, etc. So far as temperatures are concerned, the criterion should be comfort conditions for the occupants so far as appliances and conditions will allow. Information with regard to window space, number of rooms, appliances in use, type of insulation and many other factors would be required for purposes of statistical analysis and classification, and, of course, each participating member of the staff would be required to furnish particulars of weekly gas, coke and hot water consumption.

'The use of elaborate equipment is not visualised, but, while the task may appear to be formidable, the difficulties are not insurmountable, and I am sure the end would justify the means. It should be possible to work out the details of such a scheme to enable these tests on a really large scale to commence on April 1, 1958. At the end of each 12 months the test records could then be handed over to the statisticians for their consideration and observations. As a first move in this direction, a small committee representative of the different area boards should be appointed to organise a scheme. There are in this hall at the moment 150 to 180 persons, and I suggest that they might become the first volunteers for the scheme. Incidentally, they would at the same time be doing something which would go a long way to help in the sale of the industry's products.'

Mr. Norman Hudson (Commercial Manager, North Eastern Gas Board): 'In the comparison between the occupants of the two houses it is said that one of them preferred a better degree of freshness than the other. On that point I should like to suggest to the authors that in any further experiments which might be carried out account should be taken of that fact and that freshness should be provided in a controlled manner.

If this type of heating is developed extensively it will be most unfortunate for the gas industry, if people are to be left to the indiscriminate opening of windows in order to get freshness. Stuffiness is by tradition a feature of central heating systems of whatever kind they may be, and I think that in regard to the provision of warm air in the manner described in the paper, this problem of stuffiness could easily be overcome if a single bleed-in flow of fresh air from the outside was brought in to the inlet of the pan laid in the flooring and under the control of the occupant by means of a simple butterfly valve. Unless we allow the occupant of a house to have control over freshness, then we shall get conditions where the gas-fired furnace or warm air system will be heating the garden as well as the house.

'Another point which emerges from the paper is the matter of the doubt as to the need to supply warm air direct to bedrooms. I have been particularly interested in the warm air problem for some years now, and I believe that we have something to learn from the Americans in this respect. Granted that they have houses of open construction type, but their general approach to this problem is to deliver warm air in the house at either low or high level, at one or two appropriate general points rather than specific points, and to allow circulation effected by the operation of the warm air furnace to achieve equality of temperature throughout the dwelling. I feel that the experiments carried out by the authors are tending to prove that in the normal domestic dwelling there is no need to go in for expensive ducting.

Target Should be Set

'There is much in the point made by Mr. Fuidge, namely, that we should set a target for what we want to achieve, and then quickly and definitely install the necessary apparatus and get field test results. I think the figures given in the paper are sufficient to indicate the line of approach that we should make. For that reason, they are possibly the most valuable contribution that we have received for a long time; this may produce the biggest new load that the gas industry has obtained this century.'

Mr. Wills, in reply: 'I agree entirely with Mr. Hudson that we should control the ventilation very much more closely in the the future than we have done in the past. I assure Mr. Currier that we are looking ahead to the field test and statistical analysis, and I thank him for his support for this approach. In reply to Mr. Brook, I would say that this was a comparison of factual data, and we were comparing the system with a coke system and went no further than to say the comparison was of that kind. We agree that there are coke systems with higher efficiencies and perhaps greater flexibility, but we still say that with warm air the flexibility is greater than with central heating systems generally. I agree mainly with the remarks of Mr. Fuidge, but I would utter a word of warning about the analysis of performance in respect of a very short period test. An extension to a whole season's results is far less accurate than to take six years and squeeze them into one season, but that is part of the approach, and if it is wisely used I do not see why it should not be useful. I tried to describe the inherent limitations in relation to system efficiency. All I can add is that I agree with Mr. Fuidge and Mr. Dick.'

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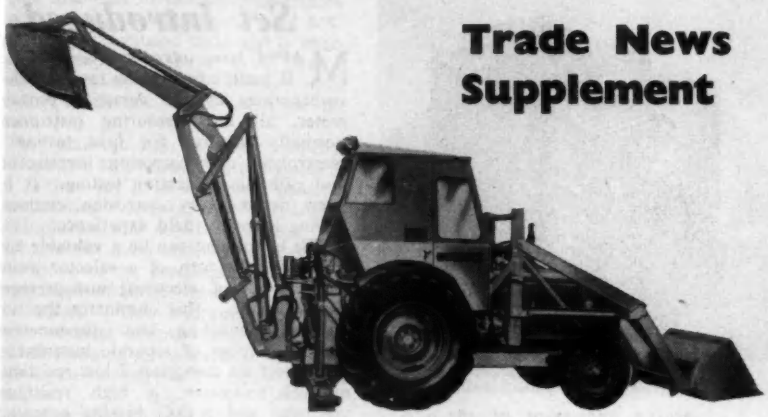

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Like many other outstanding inventions it appeared before its time and little or no interest was at first aroused, but undismayed and convinced of its ultimate success the Directors continued to publicise it in every possible way. A demonstration unit subsequently toured the British Isles and when the machine was again exhibited towards the end of 1953 orders to the value of over £100,000 were taken in a single day.

Other manufacturers realising the success of the Dinkum Digger entered the field, but throughout this time the Whitlock team of development engineers have been working on a much advanced and larger model. The results of their efforts are to be seen in the Dinkum Digger Major, which made its first public appearance at the Building Exhibition.

A continuous slew and digging action through an arc of 190° with a reach of 18 ft., a loading height of 12 ft. 6 in., and powerful excavation to a depth of 14 ft. with a range of buckets from 10 in. to 54 in. are but a few of the features of this new machine.

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All vulnerable high pressure hoses have been drastically reduced to an average length of only 20 in. by building drawn steel tubes into the main jib, and into the frame and slewing post, and these hoses are all tested to 6,000 lb. per sq. in.

A unique design of rotary valve is built into the slewing post and this combined with swivel bearing couplings protects the power hose lines from all stresses and strains.

The Dinkum Digger Major is rigidly mounted on a specially built Fordson diesel power unit and of particular interest are the independently operated hydraulic stabilising outriggers with telescopic extensions enabling the excavator to be instantly levelled up under all conditions from the control seat.

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The operator has likewise not been forgotten. An adjustable upholstered seat is fitted in a truly all-weather cabin the rear window of which is hinged to open right down; the side windows slide and the roof may be removed in a matter of seconds.

With the Dinkum Digger Major has also been introduced the Whitlock Power Shovel of 3/4 cu. yd. capacity, a larger version of the well-known Dozaloda, which will strip, dig, and load as well as bulldoze, and this loader fitted in conjunction with the New Excavator is fully capable of tackling all site work including deep trenching and mass excavations. A heavy-duty clutch, heavy-duty front axle and massive tyre equipment are included to stand up to the strains and stresses likely to be imposed upon this powerful machine.—*Whitlock Bros. Ltd., Great Yeldham.*

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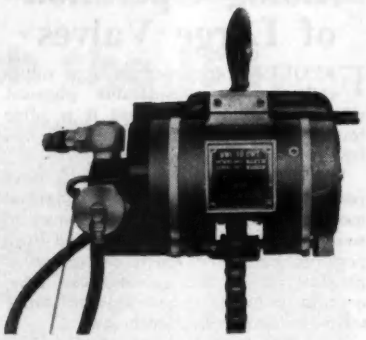


Saving in Time

Used as individual units, these hoists afford a marked saving in time and are ideal for the transfer of components in the machine shop, erection shop or loading bay. Crane waiting time is eliminated and the production lines kept flowing smoothly to schedule. Its reliability is unquestioned.

Other special features include mechanical brake with bonded lining, ball or needle-bearing mounting for all rotating or oscillating parts, ¾ in. B.S.P. air inlet swivel with 180° swing, and built-in oil reservoir.

Control is effected by the throttle which gives precision speed control from inching to the rated maximum; with standard head, the hoist will lift 10 cwt. at 25 ft. per minute. Top and bottom hooks have a safety snap. An adjustable chain stop limits the lift or drop. The automatic brake locks when power is shut off and the load stays up in any air line failure, but can be lowered safely and speedily by throttle control.

All parts, including chain, hooks, connections, pins, swivels, supports and housing will withstand a load far above the hoist's rated capacity, so that there is no danger of breakage from sudden starts and stops. The vane-type motor is totally enclosed and the exhaust noise reduced to a minimum. The motor cannot burn out if stalled indefinitely and is unaffected in ordinary operation by dirt, fumes or heat.—*Broom & Wade Ltd., High Wycombe.*

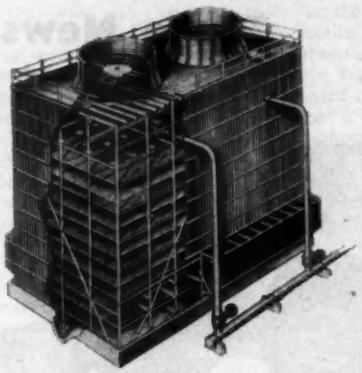
New Design of Cooling Tower

HEAD Wrightson Processes Ltd., announce that work has been completed on a new design of their 'Counterflo' induced draught cooling tower. This type of tower, illustrated here, is widely used in the United States and Head Wrightson Processes offer this equipment in the United Kingdom and British Commonwealth under licence from the Fluor Products Company of Los Angeles.

Continuous research into improved methods of industrial cooling has produced some novel design features for the water and air distribution in this new design of tower. The 'Counterflo' induced draught cooling tower can be composed of one or a number of cells each equipped with an induction fan which draws the air through the tower from louvre intakes. Water is distributed down the tower from a novel all-timber but totally enclosed distribution system through splash type grid decks, thus providing a counterflow action.

The tower is constructed of prefabricated timber or concrete units and these factory made components can be erected on site by unskilled labour teams. A new feature is the inclusion of asbestos panels as sheathing for towers in certain circumstances. Erection of all types is rapid and simple and great flexibility is achieved in operation by individual cell control.

'Counterflo' cooling towers are being used at oil refineries, chemical plants and on many industrial sites throughout this country and the rest of the world. Recently a concrete version of the 'Counterflo' tower was supplied to a Government Department to cool 4 mill. gal. of water an hour; this is in fact the largest installation of its kind in the United Kingdom.



Artist's impression of the new cooling tower.

These towers are replacing the more conventional hyperbolic or 'milk can' shaped natural draught towers, which are still to be seen in this country, and their low height and unobtrusive appearance have a strong appeal to architects and local planning committees. —*Head Wrightson & Co., Ltd., Ship House, 20, Buckingham Gate, London, S.W.1.*

New Mapel Multi Combination Test Set Introduced

MAPEL have introduced a new Mark II multi combination test set, which incorporates in one versatile, portable meter, all the measuring instruments normally required for field testing in electrolysis and corrosion investigation and cathodic protection testing. It has been designed by corrosion engineers having extensive field experience.

The instrument can be a valuable time saver; by the turn of a selector switch many types of electrical measurements can be made. This eliminates the time wasted connecting and disconnecting from a number of separate instruments.

The test set comprises a low resistance millivolt/voltmeter; a high resistance voltmeter and a D.C. biasing potential; which can be used in series with it; a potentiometer voltmeter; and a milliamp/ammeter.—*Metal and Pipeline Endurance Ltd., Artillery Mansions, Victoria Street, London, S.W.1.*

New Chemico Pack Introduced

IN response to many requests from the trade, The County Chemical Co. Ltd., makers of the popular Chemico smooth paste cleanser, have introduced a new 6 lb. economy size pack.

The tin, in the well known and attractive pink, red, and blue Chemico colours, is fitted with a convenient handle for carrying.—*County Chemical Co., Ltd.*

Aiding Operation of Large Valves

FREQUENT operation of large valves calls for a considerable physical effort by the operator, and it is often found necessary to bring in additional labour to assist in this work.

W. C. Holmes & Co. Ltd., have recently introduced a new mechanical method of operating the larger sizes of western valves. Power is supplied by a portable air motor which eliminates all physical effort; one operator can open or close even the largest valve in thirty seconds. See illustration below.

This method is not intended to replace the known fully automatic method of operation, but is intended as a less costly alternative when full mechanisation is not necessary.— *W. C. Holmes & Co., Ltd., Turnbridge, Huddersfield.*

Now, a Wall Mounted Satellite

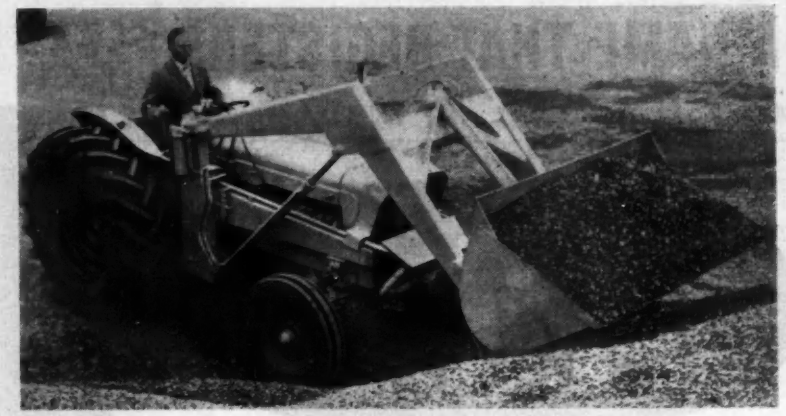
With the addition of a new wall-mounted model practically every aspect of industrial and commercial heating is covered by the Satellite range of Bratt Colbran luminous heaters. The angle at which the heater may be set is adjustable between a minimum of 20° and a maximum of 45° to the vertical. Thus, where there is sufficient mounting height, the heater may be tilted fully forward to give a very high proportion of downward radiation.—Bratt Colbran, Ltd., 10, Mortimer Street, London, W.1.

J.C.B. Loadall Marks Big Advance

THE new J. C. B. Loadall, seen for the first time at the Building Exhibition, is one of the developments of J. C. Bamford (Excavators) Ltd., and is introduced to supersede the J. C. B. Major, which has given excellent service, under varying conditions in all parts of the world.

This machine has, in some respects, retained the well-established principles of the Major, yet it is extremely modern, incorporating outstanding hydraulic developments and structural design.

One of the main improvements of this machine over its predecessor is the incorporation of power crowd when using the bucket. This hydraulic operation gives complete control over the digging and discharging of materials, and also enables the operator to dig below ground level.



Another advanced feature of the Loadall is the use of the main structure as an oil tank. The design of the hydraulic system is such that the oil is drawn from one side of the main support right through the all-welded structure of the sub-frame to the rams, and back to the reservoir via filters. The main advantage of this system is that the greater circulation of oil ensures that it does not become over-heated.

The powerful rams, which are all of J. C. B. design, result in a breakout force of 4,000 lb. The Loadall has a maximum discharge height of 9 ft., a forward reach at maximum discharge height of 2 ft. 6 in., and a range of buckets from ¼ cu. yd. (narrow) to 1½ cu. yd. (full width).

Another great advantage is the ease of detachment from the tractor. The Loadall can easily be taken off, leaving the tractor available for other work. Particular attention has been paid to the transfer of the load under impact into the main rear mounting fitting on to the tractor.

The Loadall will carry out every type of loading work at hospitals, gasworks, factories and coal mines. It can be used for stockpiling (in particular, coke and coal), and can speedily and efficiently carry these materials from the stockpile to the boiler.—*J. C. Bamford (Excavators), Ltd., Lakeside Works, Rochester, Uttoxeter, Staffs.*

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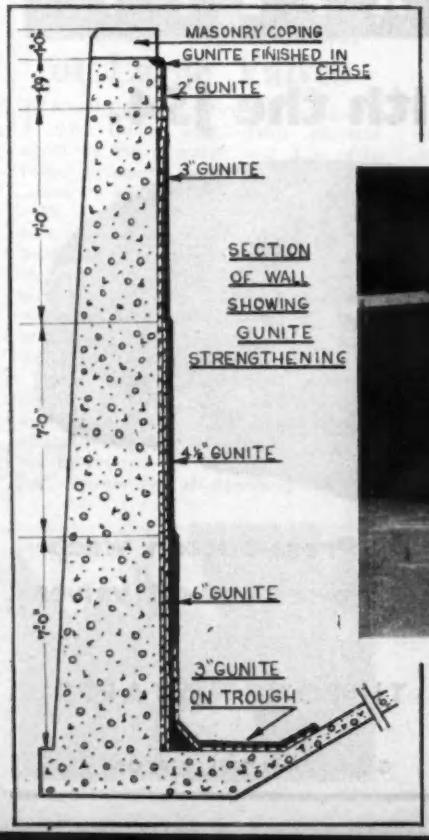

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This 50 year old gasholder tank at Pontefract Gas Works is 92' 6" in diameter and 23' 9" deep. The foundations had failed and the tank was severely cracked and losing over 23,000 gallons per day. We lined the wall with gunite reinforced to take the full ring tension, and carried out extensive pressure grouting of the underlying rock to stabilise the foundations.

Employing Authority :—
North Eastern Gas Board, Wakefield Group

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Classified Advertisements: All small classified advertisements are charged at 2/6 per line (approx. 7 words)—minimum charge 10/–. A Box Number address occupies 2 lines, and a further 6d. is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's Journal.

Displayed Advertisements: Rates obtainable on application to the Business Manager. Change of copy for displayed spaces must be received 14 days prior to publication if proofs are required. Type area of inside pages 10 in. deep × 7 in. wide; block screen 120.

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APPLICATIONS are invited for an ASSISTANT INDUSTRIAL GAS ENGINEER, within the salary range of A.P.T. 10 (Provincial 'A,' £860-£960 per annum) of the National Salary Scales for Gas Staffs.

Applicants should have experience in the design, construction and installation of industrial and commercial equipment, and should have passed the Associate Membership Examination of the Institute of Gas Engineers, or possess an equivalent qualification.

The successful applicant will be required to pass a medical examination.

The post is pensionable.

Applications, stating age, educational qualifications and experience, together with the names of two referees, should be addressed to the undersigned not later than two weeks following the appearance of this advertisement.

C. B. MAWER,
Secretary to the Board.

2, Windsor Place,
Cardiff.

WEST MIDLANDS GAS BOARD

VACANCY FOR SENIOR ASSISTANT, FUEL SECTION

A VACANCY has occurred in the Area Chief Chemist's Department, located in Birmingham, for a SENIOR ASSISTANT, Fuel Section.

Candidates should possess the Higher National Certificate in Chemistry or an equivalent qualification and have an interest in statistical method.

The salary will be within the range of Grade APT 8 (£745-£825 per annum) of the National Salary Scales.

The post is pensionable, and the successful candidate may be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham 15, to reach him not later than December 31, 1957.

J. SWAN,
Secretary to the Board.

WEST MIDLANDS GAS BOARD

VACANCY FOR ASSISTANT CHEMIST

A VACANCY has occurred on the Area Chief Chemist's staff for an ASSISTANT CHEMIST for general duties, based in the laboratories at Birmingham.

The salary will be within the range of Grade APT 7 (£705-£785 per annum) of the National Salary Scales for Gas Staffs.

The post is pensionable, and the successful candidate may be required to pass a medical examination.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham 15, to reach him not later than December 31, 1957.

J. SWAN,
Secretary to the Board.

NORTH EASTERN GAS BOARD

YORK-HARROGATE GROUP
TECHNICAL ASSISTANT (INDUSTRIAL)

APPLICATIONS are invited for the above post at a salary within Grade A.P.T. 9 (Provincial 'A') (£795-£895 per annum) of the Salary Scales agreed by the National Joint Council for Gas Staffs. The commencing salary will be dependent upon qualifications and experience.

Applicants must possess intimate knowledge of the use of fuel in the industrial and commercial field, and should be capable of planning and supervising gas installations of all kinds.

The possession of the Higher Grade Certificate in Supply of the Institution of Gas Engineers or equivalent qualification is desirable.

The successful applicant will be required to pass a medical examination and to join the Board's Staff Pension Scheme.

Applications, together with full details of training, qualifications and experience, should reach the Group General Manager, North Eastern Gas Board, York-Harrogate Group, 48, James Street, Harrogate, by January 4, 1958.

J. C. GARDNER,
Secretary.

NORTH WESTERN GAS BOARD

WIRRAL GROUP
TECHNICAL ASSISTANTS (PRODUCTION)

APPLICATIONS are invited from suitably qualified persons for the above pensionable appointments at salaries within Grade A.P.T. 7 (£705/£785 p.a.).

Applications, on the official form which can be obtained on request, should be returned not later than Monday, January 6, 1958, to the General Manager, N.W.C.B., Wirral Group, Hind Street, Birkenhead.

NORTH WESTERN GAS BOARD

NORTHERN GROUP
INSTALLATIONS OFFICER—BARROW DISTRICT

APPLICATIONS are invited for the above pensionable appointment at a salary within Grade A.P.T. 7/8 (£705/£825 p.a.).

The successful applicant will be responsible to the District Service Manager for the organisation and control of installation and maintenance staffs. Candidates should hold a qualification in Gas Engineering (Supply) and/or in Gasfitting. Preference will be given to those with experience in the commercial and industrial uses of gas.

Detailed applications, giving the names of two referees, should reach the General Manager, Northern Group, N.W.G.B., Gas Works, St. George's Quay, Lancaster, within 14 days.

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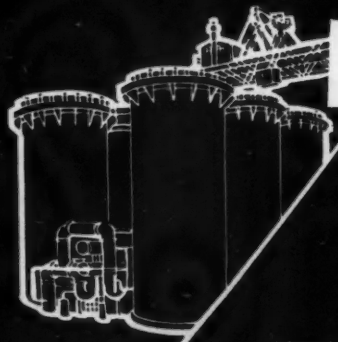

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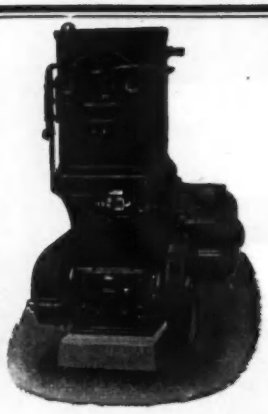

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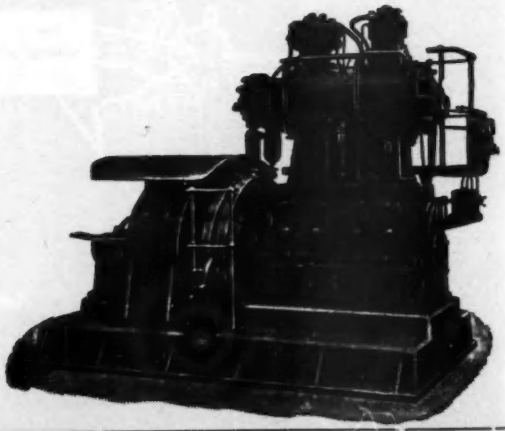

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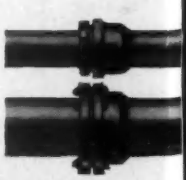

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